Annals
of the
Missouri Botanical Garden

Volume XXV

1938

With Sixty-nine Plates and Twenty-two Figures

Published quarterly at Fulton, Missouri, by the Board of Trustees of the Missouri Botanical Garden, St Louis, Mo.

Entered as second-class matter at the post-office at Fulton, Missouri, under the Act of March 3, 1879.

Annals

of the

Missouri Botanical Garden

A Quarterly Journal containing Scientific Contributions from the Missouri Botanical Garden and the Graduate Laboratory of the Henry Shaw School of Botany of Washington University in affiliation with the Missouri Botanical Garden.

Information

The ANNALS OF THE MISSOURI BOTANICAL GARDEN appears four times during the calendar year: February, April, September, and November. Four numbers constitute a volume.

Subscription Price........$6.00 per volume
Single Numbers .... 1.50 each *

Contents of previous issues of the ANNALS OF THE MISSOURI BOTANICAL GARDEN are listed in the Agricultural Index, published by the H. W. Wilson Company.

* Except No. 3 of Vol. 22, price $5.00, and No. 2 of Vol. 25, price $2.50.

ANNALS

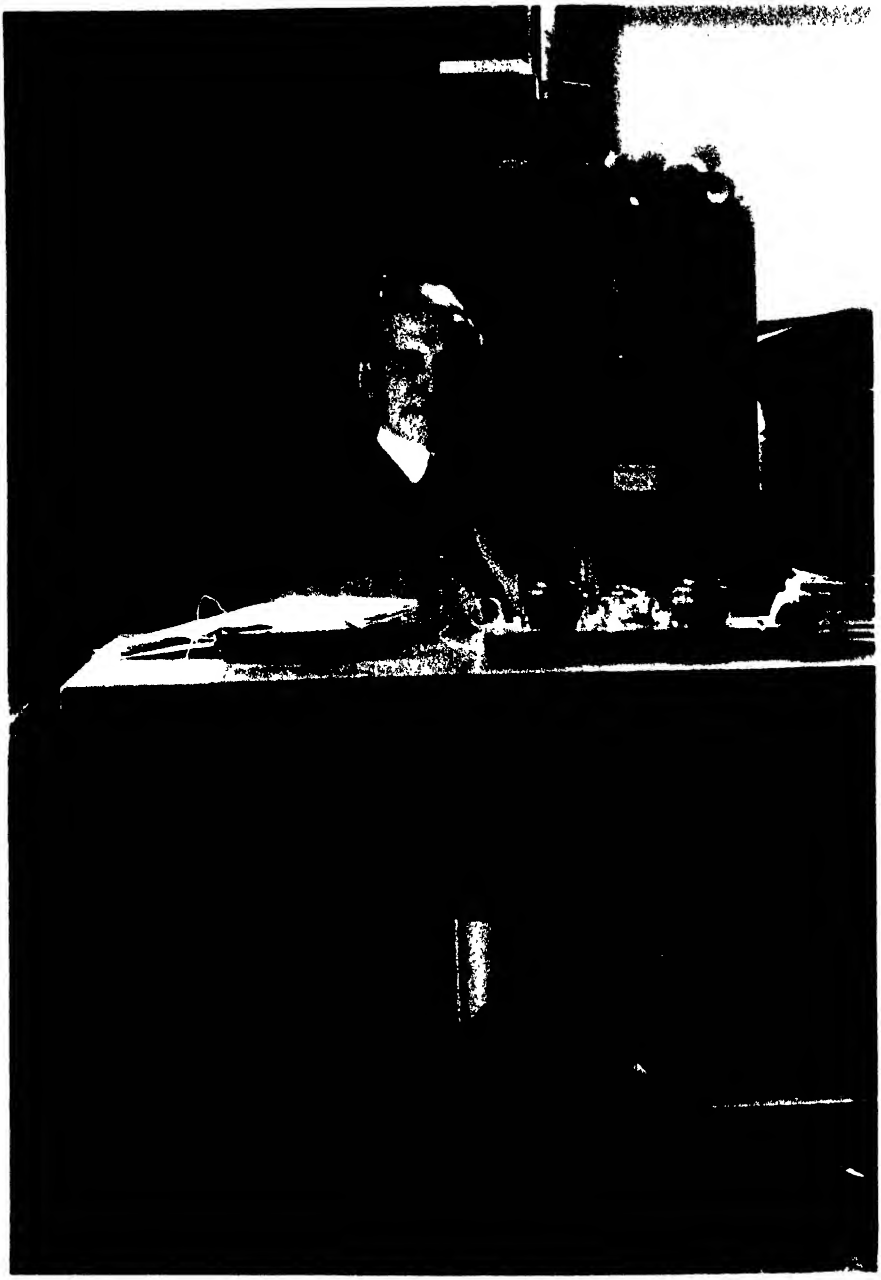
OF THE

MISSOURI BOTANICAL GARDEN

TABLE OF CONTENTS

STAFF
OF THE MISSOURI BOTANICAL GARDEN

BOARD OF TRUSTEES
OF THE MISSOURI BOTANICAL GARDEN



Jesse More Greenman

TO

JESSE MORE GREENMAN

CURATOR OF THE HERBARIUM, MISSOURI BOTANICAL GARDEN

PROFESSOR OF BOTANY, WASHINGTON UNIVERSITY

BORN DECEMBER 27, 1867

Ad Multos Annos Vivat

December 27, 1937.

Dear Dr. Greenman:

We, your pupils, have gathered today to greet you and to celebrate your academic festival. To commemorate the day, some of us have brought to the feast table these contributions. Singly, and of themselves, they are not of great significance. They are impressive because of the composite evidence they offer of the degree to which your scholarship has been projected into the second generation and beyond. They are the fruit of your teaching.

A number of years ago, one of us, in talking with your own teacher, Professor Engler, referred to himself as an academic grandchild, much to Engler's interest and amusement. Engler's generation is passed now, and you have become the dean. Your own academic grandchildren are beginning to carry forward into another generation the essence of scholarship which you have given us.

We are deeply grateful for this gift of yours, for with it we have found inspiration to emulate you. And so we come to you now, in the full fruition of your years and labor, seated in the herbarium which your effort and toil have created. May these contributions speak of our appreciation, our respect and our affection, for they recall vividly to us that tolerance and unassailable kindliness which guided us. We hope that you will find in them a source of pleasure and satisfaction.

Earl Edward Sherff
Mary M. Bryan
Alice Pickel
Edwin Blake Payson (†)
Adele Lewis Grant
Carl Clawson Epling
Louise M. Stupp
Clarence Emmeren Kobuski
Esther Louise (Larsen) Doak
Merle E. (Grenzebach) Sherard
Mildred Esther (Mathias) Hassler
Robert Everard Woodson, Jr.

Edgar Lawrence Evinger
Julia Ruth Lawrence
Hamilton High Card
Eva M. Fling Roush
Charles Leo Hitchcock
Julian Alfred Steyermark
Caroline Katherine Allen
Lily M. Perry
Mary Elizabeth Pinkerton
Ruth Vera (Cornelius) Layton
Josephine Darlington
George Jones Goodman
Mary Maxine Larisey
Ward M. Sharp
Louis Otho Williams
Fred Alexander Barkley
George Bippus Happ
Francis Marion Ownbey, Jr.
Russell Jacob Seibert
Hugh Carson Cutler
Elizabeth Ammerman

CONTENTS

Annals
of the
Missouri Botanical Garden

VOL. 25 FEBRUARY, 1938 No. 1

REVISION OF THE HAWAIIAN SPECIES OF EUPHORBIA L.[1]

EARL EDWARD SHERFF

Head, Department of Science, Chicago Normal College
Research Associate in Systematic Botany, Field Museum of Natural History

INTRODUCTION

The vast size of the genus *Euphorbia* has perhaps deterred students of the Hawaiian flora hitherto from attempting a revision of its Hawaiian species. The conflicting views regarding the integrity or unity of *Euphorbia* as a genus in the broad sense employed, for example, by Boissier (*in* DeCandolle, Prodromus **15**, pt. 2. 1862), have doubtless contributed in no small measure toward the same result. In studying the literature on *Euphorbia* and the numerous proposed segregates, I have been impressed with the interrelation of these two factors. *Euphorbia* (using the name always in its broader or Boissieran sense), by the very reason of its vastness, affords such internal diversification as to suggest various generic segregations, at the same time displaying so many intergradations among the suggested segregates as to make questionable the wisdom of their establishment.

Realizing that generic as well as other taxonomic concepts are to a great extent necessarily subjective, I have consulted not only all available specimens but also the opinions, both oral and published, of many taxonomists who have given *Euphorbia*

[1] Issued December 27, 1937.

particular attention. In a general way it has seemed that the more cosmopolitan one's studies in the genus have been, the less disposed or able he has felt to resolve *Euphorbia* into an assemblage of distinct genera. Accordingly, it would appear that in the present state of our knowledge the ends of prudence and conservatism are best respected by retaining as sections of *Euphorbia* a number of subgroups segregated by some writers as genera (e.g., *Anisophyllum, Poinsettia, Tithymalus).* In this connection, however, we may note the position taken by Otto Degener, author of the currently appearing *Flora Hawaiiensis.* Mr. Degener, who, incidentally, maintains such groups as *Poinsettia* and *Tithymalus* as distinct genera, writes me that he believes the native Hawaiian species of *Euphorbia* to be capable of segregation. He proposes to describe soon a new genus, this to include all the native Hawaiian species, varieties, and forms given in the following pages. Whether Mr. Degener's view will eventually be embraced by conservative taxonomists, time alone can reveal. His view was known to me, however, several years ago and has been kept in mind throughout my studies.[1] It would seem to me that at the most, and perhaps only in an arbitrary way, the native Hawaiian species could be made to constitute an additional section of *Euphorbia,* standing next to the section *Anisophyllum.* (In Boissier's classical treatment, the native Hawaiian species known to him were placed in sect. *Anisophyllum,* subsects. *Gymnadeniae* and *Sclerophyllae.)*

Several years ago, the large collection of native and introduced species of *Euphorbia* and other genera of the Euphorbiaceae belonging to the Bernice P. Bishop Museum of Honolulu was sent to me for study. This was later supplemented by the still larger collection belonging to Mr. Degener. Both collections included a large quantity of unmounted duplicate material, intended for subsequent distribution and, in the case of

[1] Since the above text was written, Mr. Degener has joined Leon Croizat (Degener, Fl. Haw. Dec. 9, 1936 [originally misprinted November 9, 1936]) in referring all the Hawaiian endemic species to *Chamaesyce.* The new nomenclatural combinations arising from this treatment have been inserted as synonyms in my text, without comment.

the Degener plants, often reaching a total of a dozen or more specimens for a single number. From time to time, through the friendly cooperation of the authorities at Field Museum of Natural History, Chicago, where primarily my work has been carried on, the collections of many of the principal European and American herbaria have been borrowed for examination. In this way it was possible to study directly almost all of the types of the previously described Hawaiian species and varieties of *Euphorbia*. In the very few cases where types, also original descriptions, were inacessible to me, the attendant difficulty has been surmounted through the exceedingly kind assistance of those in charge of certain herbaria and libraries.

To the institutions which, by the cooperation of their directors or staff members, made this revisional study possible, it is a pleasure to acknowledge here my deepest gratitude. Particularly must I express my indebtedness to the following individuals: Miss Ethelyn M. Tucker, Librarian, Arnold Arboretum; Dr. Ludwig Diels, Director, and Dr. Johannes Mattfeld, Curator, Botanical Garden of Berlin; Dr. Herbert E. Gregory, formerly Director, Dr. Peter H. Buck, present Director, Mr. Edwin H. Bryan, Jr., Curator of Collections, and Miss Marie C. Neal, Botanist, Bernice P. Bishop Museum; Dr. John Ramsbottom, Keeper of Botany, British Museum of Natural History; Dr. Karl M. Wiegand, Professor of Botany, Cornell University; Mr. Otto Degener, author of the *Flora Hawaiiensis;* Dr. B. P. G. Hochreutiner, Director of Botanical Garden of Geneva and of Delessert Herbarium; the late Mr. Stephen C. Simms, formerly Director, Dr. B. E. Dahlgren, Head Curator of Botany, Mr. Paul C. Standley, Curator of the Herbarium, and Mr. C. H. Carpenter, Photographer, Field Museum of Natural History; Dr. Carl Skottsberg, Director, Arboretum of Gothenburg; Dr. Elmer Drew Merrill, Administrator of Collections, and Mr. Charles A. Weatherby, Assistant Curator at Gray Herbarium, of Harvard University; Sir Arthur W. Hill, Director, and Dr. J. Hutchinson, Botanist, of the Royal Botanical Gardens of Kew; Dr. Boris Keller, Director, and Dr. V. P. Savicz, Assistant Director, Botanical Garden of Leningrad; the late Dr. Marshall Avery Howe, formerly Director, and Dr.

Henry Allan Gleason, Deputy Director and Head Curator, New York Botanical Garden; Dr. Henri Humbert, Director, Museum of Natural History, Paris; Dr. William R. Maxon, Associate Curator, United States National Museum; Dr. Karl Keissler, Director of the Department of Botany, Natural History Museum, Vienna.

In the foregoing list I have purposely omitted the name of Dr. Jesse More Greenman, in whose honor the present volume is being published and to whom I would here tender special thanks. As one of Dr. Greenman's earliest students in plant taxonomy, it is with a deep sense of gratitude, not only for his aid in lending specimens for the study here represented but for his wise direction and friendly counsel in former years, that I join some of his later students in seeking here to pay him tribute.

I have photographed upwards of one hundred of the more important specimens studied. Complete sets of the photographs are in my private collection and in the herbarium of Field Museum of Natural History, Chicago. These photographs have been drawn upon exclusively for the accompanying plates.

Wherever the term "cotype" is used in the legends accompanying the plates, or elsewhere in the text, it is used to connote a duplicate of the type, as shown, for example, by the use of the same collection number.

Names of institutions or individuals at present possessing the specimens cited in this Revision (and referred to in the text usually by the names or abbreviations in parentheses) follow: Botanical Garden of Berlin (Berlin); Bernice P. Bishop Museum, Honolulu (Bishop); British Museum of Natural History, London (British); Cornell University, Ithaca (Cornell); Mr. Otto Degener, Waialua, Isl. Oahu (Degener); Delessert Herbarium, Geneva (Delessert); Field Museum of Natural History, Chicago (Field); Botanical Museum of the University of Florence (Florence); Arboretum of Gothenburg (Gothenburg); Gray Herbarium of Harvard University, Cambridge (Gray); Royal Botanical Gardens of Kew (Kew); Botanical Garden of Leningrad (Leningrad); Linnean Herbarium, Lon-

don (Linnaeus); University of Minnesota (Minnesota); Missouri Botanical Garden, St. Louis (Missouri); New York Botanical Garden, New York City (New York); Museum of Natural History, Paris (Paris); Academy of Natural Sciences, Philadelphia (Philadelphia); United States National Museum, Washington, D. C. (U. S.); Natural History Museum, Vienna (Vienna).

Genus Euphorbia L.

Euphorbia L. Gen. Plant., edit. 5, p. 208. 1754.

Herbs, shrubs, or trees, of widely diverse habit, with milky juice, our species leafy; leaves alternate or the upper or all opposite, entire or toothed or rarely lobed; stipules present or absent, in foreign succulent species often transformed into spines (or prickles) above a pair of larger spines; in our native species the two stipules of each interpetiolar space fused into a single body. Flowers aggregated in capitula (cyathia), these resembling small hermaphrodite (or in some foreign species male) flowers; a single capitulum consisting of a number of stamens (really male flowers, each consisting of a single stamen jointed to a pedicel—staminophore—and soon falling away from it, without or rarely with a minute perianth just above the articulation) mingled with membranaceous scales or bracteoles, with (or in some foreign species without) a stipitate ovary (really a pedicellate female flower, with or without a minute 3-lobed or very rarely cup-like or tubular perianth at the base of the ovary, but without a membranaceous tubular involucel surrounding the pedicel) in their midst, contained in a calyx-like cup-shaped involucre. Involucre consisting of an outer series of 1–8 (usually 5) glands; these distinct and equally spaced or rarely united, entire or 2-horned or divided or appendaged at margin with a sometimes petaloid extension, alternating with an inner series of 4–8 (usually 5) membranaceous erect or inflexed fringe-toothed lobes. Anthers 2-celled; cells usually subglobose and more or less diverging, longitudinally dehiscent. Ovary partly or wholly included or (in our species commonly) exserted, 3- (rarely and then only for some foreign species 2-) celled, containing in each cell (coccus) a

single ovule (this pendulous from the apex of the cell's inner angle); styles 3 or rarely 2, free or more or less united below, entire or more or less deeply bifid at apex. Fruit a 3- (rarely 2-) celled capsule; cells separating at maturity from the central persistent axis and opening along their inner face into 2 valves, liberating the seed; inner part of valves hard or cartilaginous. Seeds with a thin crustaceous testa, smooth or variously sculptured, our native species lacking but many other species having a caruncle; embryo straight, with flat cotyledons, enclosed in a thick albumen. (Description of genus based in considerable part upon that by the late Dr. N. E. Brown *in* Thiselton-Dyer, Flora of Tropical Africa **6**: sect. 1: 470. 1911.)

KEY

a. Fruticose or arborescent; leaves all opposite and distichous; stipules on each side fused into a single more or less triangular or crescentic interpetiolar body; involucral glands entire; seeds ecarunculate; native species.
  b. Inflorescence commonly several times branched and becoming 1.5–6 (or even 7.5) cm. long, open, heads usually 5–20.
    c. Capsules 1.3–2.2 cm. long, bright pink to dark crimson or scarlet; pedicels thickish; native of northeastern Oahu............*3. E. Rockii*
    c. Capsules smaller, pedicels capillary or nearly so.
      d. Leaves scarcely petiolate, petioles 1–3 mm. long; plants of Oahu.
        e. Veins of leaves obscure on upper surface; blade commonly 4–9 cm. long and 2–3.4 cm. wide........................*1. E. Clusiaefolia*
        e. Veins of leaves manifest on upper surface; blade commonly 7–16.5 cm. long and 2.5–4.5 cm. wide......................*2. E. Forbesii*
      d. Leaves definitely petiolate, the slender petioles 5–18 mm. long; native of Kauai............................*4. E. Remyi* var. *λ. kauaiensis*
  b. Inflorescence monocephalous, or if polycephalous at least more contracted, usually less than 1.5 cm. long.
    c. Capitula usually 3–11 in each cyme.
      d. Capitular clusters (that is, cymes) dense and subglobose, 4–8 mm. long; blades of principal leaves obtuse at apex, narrowed at base, 2–3.3 cm. wide; native of Kauai....................*5. E. halemanui*
      d. Capitular clusters mostly longer than broad, or flattened but hardly dense or subglobose.
        e. Leaf-blades oblong-elliptic, at apex mostly subacute to acute; inflorescence 0.5–1.5 cm. long......*11. E. Hillebrandii* var. *β. palikeana*
        e. Leaf-blades more or less oblanceolate, at apex rounded to obtuse or truncate-emarginate.
          f. Cymes open, the branches slender, capitula pedicelled.
            g. Leaves noticeably divaricate (except for terminal 1 or 2 pairs, which are antrorse) and distichous, more or less falcate, often 5–7 cm. long...........*6. E. Celastroides* var. *ν. lorifolia*

g. Leaves directed variously, not or scarcely falcate, seldom more than 5 cm. long.
h. Capitula in poly(±11)-cephalous cymes...6. *E. Celastroides* var. o. *niuensis*
h. Capitula solitary in the axils or clustered in 2–5-cephalous cymes................6. *E. Celastroides* var. ξ. *hanapepensis*
f. Cymes more contracted, capitula sessile to subsessile.
g. Branchlets thick, conspicuously woody, very nodose; native of northwesternmost Oahu.....6. *E. Celastroides* var. δ. *kaenana*
g. Branchlets delicate, appearing as if subherbaceous, nodes small and farther apart; natives of Kauai..........................8. *E. atrococca* and varieties β. *kokeeana* and γ. *kilaueana*
c. Capitula commonly 1–3 to a leaf axil.
d. Principal leaves with mostly orbicular-cordate blades, these commonly 1–2 cm. long.................14. *E. Degeneri* and var. β. *molokaiensis*
d. Principal leaves with ovate-oblong to linear blades.
e. Leaf-blades repand-denticulate.......................12. *E. Hookeri*
e. Leaf-blades entire or obsoletely denticulate.
f. Stipular body leaving soon a basal whitish callosity; natives of Kauai and at least formerly of Oahu........4. *E. Remyi* and vars.
f. Stipular body usually persistent, basal callosity absent or inconspicuous.
g. Leaves apically more or less acute.
h. Leaf-blades ovate; native of western Maui and perhaps also of Lanai..................12. *E. Hookeri* var. β. *integrifolia*
h. Leaf-blades narrower.
i. Leaf-blades narrowly or sometimes broadly oblong-elliptic; natives commonly of Oahu or very rarely of northwesternmost Maui....11. *E. Hillebrandii* and var. γ. *waimanoana*
i. Leaf-blades linear-oblong or oblong-linear; natives of Hawaii and West Maui..7. *E. olowaluana* and var. β. *gracilis*
g. Leaves apically more or less obtuse or rounded to truncate-emarginate.
h. Leaf-blades mostly oval to obovate, commonly 1.5–3.5 cm. wide........See under first "a" in key for 6. *E. Celastroides*
h. Leaf-blades suborbicular to linear (or even more or less obovate but) commonly less than 1.5 cm. wide (or if a few cauline leaves wider, then rameal leaves very numerous and branchlets prominently ridged and often with additional diminutive bracting leaves).
i. Involucral pedicels capillary, somewhat flexuous, becoming 1.5–1.8 cm. long......6. *E. Celastroides* var. μ. *nematopoda*
i. Involucral pedicels (if present) stouter or shorter or both.
j. Capitula usually many to a branchlet, each node of which may bear a short slender flowering axis in one axil.
k. Capitula sessile to subsessile.
l. Leaf-blades mostly less than 2 cm. long; petiole tomentose.

m. Leaves silvery-tomentulose beneath...........
................9. *E. multiformis* var. *θ. kaalana*
m. Leaves glabrous on both surfaces............
..................9. *E. multiformis* var. *ι. perdita*
l. Leaf-blades mostly 3–4.5 cm. long; petiole glabrous
..................6. *E. Celastroides* var. *δ. kaenana*
k. Capitula pedicellate.
l. Capitular pedicels (on well developed specimens) ±13 mm. long....6. *E. Celastroides* var. *λ. Humbertii*
l. Capitular pedicels 3–8 mm. long.
m. Leaves noticeably divaricate (except for terminal 1 or 2 pairs, which are antrorse) and distichous, more or less falcate, often 5–7 cm. long............6. *E. Celastroides* var. *ν. lorifolia*
m. Leaves directed variously, not or scarcely falcate, seldom more than 5 cm. long..........
............6. *E. Celastroides* var. *ξ. hanapepensis*
j. Capitula few to a branchlet.
k. Capitula sessile or subsessile (pedicel less than 2 mm. long).
l. Mature seeds mostly tetragonal, 1.7–2 mm. long.
m. Leaves mostly broad-obovate to almost rotund.
n. Leaves densely crowded, ultimate branches (unless in form *kahanana)* mostly short and thick like penultimate ones, involucres usually sessile, capsules glabrous or nearly so; native of easternmost Molokai and (f. *kahanana)* eastern Oahu....................
.............6. *E. Celastroides* var. *ι. halawana*
n. Leaves few or many but ultimate branches mostly slender to even capilliform and thus unlike penultimate ones, involucres usually subsessile or short-pedicellate.
o. Capsules appressedly and more or less arachnosely whitish-hispid, finally glabrate at some places; native of northwestern Hawaii..6. *E. Celastroides* var. *κ. saxicola*
o. Capsules glabrous (or perhaps hispid for *13. E. festiva* and *9. E. multiformis* var. *η. tomentella*, natives of Oahu).
p. Young branchlets pubescent.
q. Branchlets, involucres, and pedicels tomentulose ....
......9. *E. multiformis* var. *η. tomentella*
q. Branchlets spreading-hispidulous.
r. Leaf-blades commonly cuneate-obovate; involucral glands somewhat

spreading; native of East Maui.... ...*9. E. multiformis* var. *γ. haleakalana*

r. Leaf-blades more often broad-oval to linear-elliptic; involucral glands appressed; natives of southwestern Oahu and northwesternmost Molokai ....*10. E. Skottsbergii* and vars. *β. kalaeloana* and *γ. audens*

p. Young branchlets glabrous or essentially so.

q. Dwarf shrub up to 6 dm. tall; capitula few, solitary in upper axils; bog plant of southern Kauai................. ......*9. E. multiformis* var. *ζ. sparsiflora*

q. Shrub or tree, capitula few or numerous.

r. Leaf-blades oblong or more rarely ovate-oblong, at base broadly subcordate or even moderately cordate, on each margin commonly very obsoletely 1–8-denticulate..*13. E. festiva*

r. Leaf-blades variously narrow-oblong to obovate, at base more or less cuneately narrowed, at margins entire *9. E. multiformis* and var. *β. microphylla*

m. Leaves mostly oblanceolate or narrower.

n. Ultimate branchlets capilliform or nearly so ....*9. E. multiformis* var. *δ. kapuleiensis*

n. Ultimate branchlets mostly coarser.

o. Ultimate branchlets slender, often subherbaceous, their internodes rather elongate.

p. Leaves entire........................ ....*9. E. multiformis* var. *ε. manoana*

p. Leaves commonly 3–10-denticulate on each edge..*10. E. Skottsbergii* var. *δ. Vaccinioides*

o. Ultimate branchlets thickish, ligneous, their internodes short...................... ....*6. E. Celastroides* var. *π. amplectens*

l. Mature seeds mostly biconvex, 1-4–1.6 mm. long ....*6. E. Celastroides* var. *ρ. mauiensis*

k. Capitula all or many definitely slender-pedicellate (pedicel 4–7 mm. long)....................... ....*6. E. Celastroides* var. *ζ. haupuana*

a. Herbaceous, annual or perennial; introduced species.

b. Involucral glands with petaloid (not corniculate) appendages.

c. Capsule glabrous................................*16. E. Hypericifolia*

c. Capsule pubescent.

d. Capitula in peduncled clusters..........................*15. E. hirta*

d. Capitula in axils of leaves or leaf-like bracts.
e. Capsule whitish-ciliate along and sometimes near its angles; stipules on upper side of stem usually distinct linear and pilose, those on lower side united into one deltoid or deltoid-ovate body, this apically laciniate-toothed.......................*18. E. prostrata*
e. Capsule apressed-hirtous; stipules all elongately lanceolate-subulate, hairy-fimbriate..............................*17. E. Thymifolia*
b. Involucral glands with corniculate appendages or none.
c. Involucral glands exappendiculate.
d. Floral leaves white or pale-pink at base; seeds carinate on outer face..*20. E. geniculata*
d. Floral leaves commonly red to purplish at base; seeds ecarinate.... ....*19. E. heterophylla* and var. *β. cyathophora*
c. Involucral glands with corniculate appendages..............*21. E. Peplus*

Section 1. ANISOPHYLLUM (Haworth) Röper

Sect. 1. ANISOPHYLLUM (Haworth) Röper *in* J. E. Duby, Bot. Gall., p. 412. 1828; genus *Anisophyllum* Haworth, Synops. Plant. Succulent., p. 159. 1812.

Herbs, shrubs, or trees, common in temperate and even more so in tropical regions of the whole world. Leaves opposite in our species, at base more or less oblique. Leaf petioles each with a pair of stipules at base, each stipule fused with the nearer stipule of the opposite pair into a single interpetiolar body. Capitular involucres minute in our species, solitary or cymose; their glands not or rarely (nos. 14 and 15) appendiculate. Bracteoles among the staminate flowers of many-flowered capitula plumose, of few-flowered capitula setaceous or obsolete. Glands 4 or 5 in our species. Seeds without caruncle.—Nos. 1–18.

1. **Euphorbia Clusiaefolia** Hooker & Arnott, Bot. Beechey's Voy., p. 95. 1832; Boissier, Icon. Euphorb., *tab. 1.* 1866.

Anisophyllum nodosum Klotzsch & Garcke *ex* Klotzsch, Linn. natürl. Pflanzenkl. Tricocc. Berl. Herb. Allgem. natürl. Ordn. Euphorb., p. 22. 1860.

Chamaesyce Clusiaefolia (Hook. & Arn.) Arthur, Torreya **22**: 30. 1922.

Shrub, suberect and up to 2 m. tall or subprocumbent, branches not rigid. Leaves opposite, petiole about 2–4 mm. long; blade obovate- or elliptic-oblong, commonly 4–9 cm. long

and 2–3.4 cm. wide, at apex obtuse or rounded and often emarginate, at base narrowed and often oblique, at margins revolute, subcoriaceous, very glabrous, veins obscure (lateral ones divaricate); stipules coalesced two into one, this interpetiolar, obtusely triangular, 2–3 mm. tall. Cymes at ends of branches and in uppermost axils, 1.5–3 (more rarely –4.3) cm. long, once or again di- or trichotomous, mostly 3–6-headed. Involucre campanulate to hemispherical, outwardly glabrous to slightly glandular or pubescent, about 2 mm. tall; pedicel slender, stiff, glabrate to sparsely and irregularly pubescent, 6–14 mm. long; the widely stalked glands transversely oblong and reniform, purplish-black when dried, exappendiculate; lobes 4 or 5, short-obovate to ovate-rounded, denticulate; stamens numerous, their bractlets split into linear lobes and fimbriate. Capsule cernuous, glabrous, 6–9 mm. long, the cocci usually somewhat convex on each side of the subobtuse keel; stipe slender, pubescent, 3–5 mm. long. Seeds oblong-cylindric, obscurely 4- or 5-sided, obtuse at both ends, pinkish-white to reddish-brown, glabrous but more or less lengthwise-wrinkled, about 3 mm. long.

Type: Collected by *Lay and Collie* on Captain Beechey's Voyage, Oahu, 1826–27 (Kew).

Distribution: Oahu.

Specimens examined: *Donald Anderson*, open woods, alt. 1200–1300 ft., wet ridge, Kalihi Ridge, Koolau Mountains, Oahu, January 12, 1932 (Bishop); *anon.*, Nuuanu, Oahu (Bishop); *H. F. Bergman*, Konahuanui-Olympus Trail, Oahu, February 25, 1928 (Field); *E. Christophersen & E. Hume 1411*, alt. 500–750 m., Kahuauli ridge, Oahu, December 17, 1930 (Delessert; Field, 2 sheets; Kew); *Otto Degener 8064*, dryish exposed shrubby slope, east rim of Nuuanu Valley leading to summit of Konahuanui, Oahu, February 25, 1928 (Degener, 3 sheets; Field; New York); *Degener & Eichi Masunaga 8095*, moderately dry exposed ridge, above Pauoa Flats on way to summit of Konahuanui, Oahu, April 2, 1926 (Degener, 3 sheets; Field); *Degener, Park, Potter, Bush & Topping 9964*, in open rain-forest near summit, Waimano, Oahu, June 9, 1935 (Degener; Field; Paris); *Degener, Park, Potter, Bush & Topping 9968*, forested rainy ridge, Middle Halawa Ridge, Oahu, May 26, 1935 (Berlin; British; Cornell; Degener; Delessert; Field; Florence; Gray; Kew; Leningrad; Missouri; New York; Paris; Philadelphia; Pomona; Stanford; U. S.; Vienna); *Degener, Park, Potter, Bush & Topping 10029*, near summit, Poamoho Trail, Laie, Oahu, Aug. 18, 1935 (British; Degener; Delessert; Field); *Otto Degener, D. LeRoy Topping & Colin Potter 10075*, middle Halawa, Oahu, November 10, 1935 (Berlin; British; Degener; Delessert; Field; Gray; Kew; Paris; Vienna); *Abbé Urbain Faurie 479*, Kalihi, Oahu, October, 1909

(Bishop; Delessert; Paris); *Charles N. Forbes,* Waiolani Ridge, Lanihuli Trail, Oahu, 1908 (Bishop); *Forbes,* Waiolani, west side of Nuuanu Valley, Oahu, June 28, 1908 (Missouri); *Forbes,* Waiolani, west side of Nuuanu, and Honolulu, Oahu, same date (Field); *Forbes,* Waiolani, July 8, 1908 (Field, 2 sheets; Missouri); *Forbes,* Koolauloa Mts., west of Punaluu Valley, Oahu, May 8–13, 1909 (Field); *Fo*ɪ *es 2550-O,* Konahuanui ridges, Oahu, March 17, 1919 (Berlin; Field); *Forbes & John F. G. Stokes,* Lanihuli Trail, Oahu, June 28, 1908 (Field); *D. Wesley Garber 241,* Konahuanui-Olympus Trail, Oahu, February 15, 1920 (Bishop); *Charles Gaudichaud,* Hawaiian Isls. (Berlin; Gray); *Gaudichaud 283,* same place, September–October, 1836 (Field; Paris); *Amos Arthur Heller 2345,* on lower slopes of Konahuanui, above Manoa, Oahu, May 13, 1895 (Field, 3 sheets); *Heller* (similarly) *2345,* same locality, May 23, 1895 (Cornell; Field; Gray; Kew; Missouri; New York; Paris; U. S.); *Dr. William Hillebrand,* Hawaiian Isls. (U. S.); *Hillebrand,* Nuuanu, Oahu (Kew); *Hillebrand 46,* shrub, alt. 2000–3000 ft., left of Nuuanu, Oahu, May, 1861 (Berlin; Kew; Vienna); *Hillebrand & Rev. John M. Lydgate,* Oahu (Bishop); *A. F. Judd 27,* shrub, vicinity of Kalihi, Oahu, Nov. 4, 1925 (Bishop); *Lay & Collie* (Captain Beechey's Voyage), Oahu (type, Kew); *Horace Mann & William T. Brigham,* Oahu, 1864–1865 (Cornell); *Kazuto Nitta* (Otto Degener's distrib. no.) *8181,* alt. 800 ft., Kipapa, Oahu, November 10, 1929 (Degener); *Joseph F. Rock,* Palolo, Oahu (Field); *Rock,* Konahuanui, Oahu, September, 1912 (Berlin; Field; Kew); *Rock 967,* same locality, January 7, 1909 (Berlin; Delessert; Field, 2 sheets; Kew; Vienna); *Rock 1011,* same locality and date (Gray); *Rock 3037,* Kaukonahua, Wahiawa, Oahu, May 15, 1909 (Delessert); *Topping 3066,* Wahiawa-Waikane, Oahu, March 8, 1925 (N. Y.); *Topping 3276,* Konahuanui, Oahu, February 7, 1926 (Degener); *U. S. Explor. Exped.,* Pearl River and mountains behind Honolulu, Oahu, 1840 (Missouri); *Dr. Heinrich Wawra 1647,* Oahu, 1868–1871 (Vienna, 3 sheets).

Another specimen by Forbes (Koolauloa Mountains, between Punaluu and Kaipapau, Oahu, December 14–21, 1908—Bishop) appears to be a hybrid between *E. Clusiaefolia* and *E. Hillebrandii.*

2. **Euphorbia Forbesii** Sherff, Bot. Gaz. **97**: 582. 1936.
Chamaesyce Forbesii (Sherff) Croiz. & Deg. *ex* Deg., Fl. Haw. Dec. 9, 1936.

Glabrous, probably a more or less erect shrub; stem's internodes more often 1.5–3.5 cm. long, brownish-red when dry. Leaves opposite, not numerous, petiole only about 1–3 mm. long; blade oblongly elliptic or oblanceolate, at apex obtuse and often slightly emarginate, at base oblique (and on one side often subcordate), thickish or membranous, slightly revolute, paler beneath, penninervate (lateral nerves numerous, obscure, divaricate), becoming (for the principal leaves) 10–16.5

cm. long and 2.5–4 cm. wide; stipular body widely triangular, narrowed above, about 2 mm. tall. Cymes of inflorescence axillary and terminal, open, more or less decompound (the branches and branchlets not strongly spreading), up to 7.5 cm. long, 8–15-cephalous. Involucre hemispherical, outwardly more or less pubescent, 1.5–3.5 mm. tall; glands 4 or more often 5, very broadly stipitate, transversely oblong (conspicuously reniform), exappendiculate, purplish-black when dry; lobes ovate, hispid; pedicel slender, angulate, sulcate, glabrate or more often minutely spreading-hispidulous, more often 1–2.2 cm. long. Capsule angulate-cylindric, at each end truncate, glabrous, about 6 mm. tall, cernuous, the glabrate stipe about 3–4 mm. long; styles distinct, their branches not conspicuously separated; seeds subtetragonally plano-convex, dorsally carinate, basally truncate, apically obtuse, scrobiculate, pinkish-gray, about 2.8 mm. long.

Type: Collected by *Charles Noyes Forbes*, no. *2218-O*, Wahiawa ditch trail, Oahu, August 17–20, 1915 (Field).

Distribution: Oahu.

Specimens examined: *Degener 8083*, in forest, mountains back of Wahiawa, Oahu, November 25, 1926 (Degener; Field; N. Y.); *Forbes 1623-O*, Wahiawa, Oahu, December 18, 1910 (Field); *Forbes 1770-O pro parte*, Mokuleia, slopes of Puu Kaala, Oahu, April 26–May 16, 1912 (Bishop; Field); *Forbes 2218-O* (type, Field: cotypes, Field; Kew; Missouri); *Edward Y. Hosaka 340*, alt. 1600 ft., South Opaeula Gulch, Paalaa, Koolau Mountains, Oahu, November 9, 1930 (Bishop); *Rock 3037*, Kaukonahua, Wahiawa, Oahu, May 15, 1909 (Field; Gray; New York); *Harold St. John 10629*, shrubs 8 ft. tall, alt. 1800 ft., shady woods on ridge, South Opaeula Gulch, Paalaa, Koolau Mountains, Oahu, November 9, 1930 (Berlin; Delessert; Field; Kew).

Euphorbia Clusiaefolia var. *grandifolia* Hillebr. (Fl. Haw. Isls., p. 395. 1888) was described by Hillebrand evidently from the lone sterile branch preserved in his herbarium (Berlin; the specimen is now before me). This branch came from "Makaleha in the Kaala range" and doubtless belongs either to *E. Forbesii* or to *E. Rockii*.

3. **Euphorbia Rockii** Forbes, Bishop Mus. Occas. Paps. **4**: 214, and *plate*. 1909; Rock, Indig. Trees Haw. Isls., p. 261, *pl. 101*. 1913.

Chamaesyce Rockii (Forbes) Croiz. & Deg. *ex* Deg., Fl. Haw. Dec. 9, 1936.

Erect shrub or small tree, glabrous, 1–4 m. tall. Leaves opposite, quite or almost sessile, elliptic-oblong to narrowly obovate-oblong, oblique, clasping at the rounded to cordate base, apically subobtuse, marginally revolute, subcoriaceous, pale underneath, 8–13 cm. long and 2–3 cm. wide; stipular body triangular, subacuminate above, about 2.5 mm. tall. Inflorescence of open, ±13-cephalous cymes at ends of branches and in uppermost axils, 2–6 cm. long. Involucre campanulate, outwardly glabrous or minutely pubescent, internally pubescent, barely 2 mm. tall; pedicel slender, hispidulous, 2–5 mm. long; glands transversely oblong, exappendiculate; lobes minute, ovate, hispid. Styles connate near base, shortly bilobed. Capsules ovoid to obovoid, trigonal (the cocci convex on both sides of their sharply lineate keel), glabrous, bright pink to dark crimson or scarlet, 1.3–2.2 cm. long, the stipe about 4–5.5 mm. long. Seeds globose-cylindric, blackish-brown, glabrous but lengthwise somewhat costate, 3–3.5 mm. long and about 2.6 mm. thick.

Type: Collected by *Charles Noyes Forbes and Joseph F. Rock*, Punaluu Mountains, Oahu, November 14–21, 1908 (Bishop).

Distribution: Northeastern Oahu.

Specimens examined: *Otto Degener, W. Hirai & Kwan Kee Park 8039*, windswept summit, Waikane-Schofield Trail, Oahu, April 4, 1931 (Degener; New York); *Degener, Park & Manuel Kwon 8051*, at summit of Pig God Trail, along rivulet just west of trail in exposed rain forest, overlooking Punaluu Valley, Oahu, January 17, 1932 (Degener, 3 sheets; Field); *Degener, Park, Bush, Potter & Topping 9965*, in rain-forest at summit, Pig God Trail, Punaluu, July 4, 1935 (Berlin; British; Degener; Field; Kew; Paris; Vienna); *Abbé Urbain Faurie 480*, alt. 800 m., Punaluu, Oahu, May, 1910 (British; Paris); *Forbes*, Punaluu Mountains, Oahu, November (not September) 14–21, 1908 (Missouri); *Forbes*, Punaluu Mountains, between Punaluu and Kaipapau, Oahu, same date (Field); *Forbes & Rock*, Punaluu Mts., November 14–21, 1908 (cotype, Field); *Forbes & Thompson*, same locality, May 8–13, 1909 (Berlin; Delessert; Field; Kew); *Edward Y. Hosaka 313*, alt. 2000 ft., Punaluu, Koolau Mountains, Oahu, September 28, 1930 (Bishop); *Raymond Inafuku*, wet ridge, alt. 2700 ft., same locality and date (Bishop); *A. F. Judd*, alt. 2000 ft., in woods, Kaluanui, Punaluu, Oahu, November 19, 1933 (Bishop); *N. H. Krauss*, alt. 1250–2400 ft., Kahana, Waikane-Schofield Trail, Oahu, October 16, 1932 (New York); *S. Nakagawa*, wet woods, Punaluu, half-way to top of Koolau Mountains, Oahu, September 28, 1930 (Bishop); *Rock*, Punaluu

Mountains, Oahu, August, 1908 (Gray; New York); *Rock*, same locality, November, 1914 (Berlin; Delessert; Field; Kew; Paris); *Rock 112*, same locality, November 14–21, 1908 (Berlin; Delessert; Kew; Vienna; really type material); *Rock 412*, shrub with dark crimson capsules, summit ridge of Punaluu, Oahu, December 3–14, 1908 (Bishop); *Rock 697*, Punaluu, Koolau Mountains, December 3, 1908 (Gray); *Dr. Carl Skottsberg 384*, Makaleha Valley, Waianae, Oahu, August 30, 1922 (Bishop); *Skottsberg 1846*, ridges above Kahana Bay, Oahu, September 17, 1926 (Bishop); *Harold St. John 10097*, scarlet fruit, tree 20 ft. tall, alt. 2000 ft., tall wooded stream bank, Kaluanui, Oahu, November 30, 1929 (Berlin; British; Field; Paris); *St. John 10578*, alt. 2300 ft., thicket on crest of ridge, Punaluu, September 28, 1930 (Bishop); *Topping 3271*, Wahiawa-Waikane Trail, Oahu, December 27, 1925 (Degener; New York).

4. Euphorbia Remyi A. Gray *ex* Boissier *in* DC., Prodr. **15**, pt. 2: 1262. 1862.

Euphorbia Remyi var. *α.* A. Gray *ex* Boiss., loc. cit.

Euphorbia Remyi A. Gray *ex* H. Mann, Proc. Amer. Acad. **7**: 201 (Enum. Haw. Pl., no. 438). 1867 (as to plant, *Remy 598*, from Oahu).

Chamaesyce Remyi (A. Gray) Croiz. & Deg. *ex* Deg., Fl. Haw. Dec. 9, 1936.

a. Inflorescence open, branched, 3–7-cephalous.
  b. Involucres about 3 mm. across the top, capsules with broad lengthwise bands of dense tomentum; plant of northern Kauai....var. *μ. hanaleiensis*
  b. Involucres about 4 mm. across at top, capsules essentially glabrous; plant of southern Kauai..............................var. *λ. kauaiensis*
a. Inflorescence of 1 or even 2 or 3 unbranched monocephalous peduncles.
  b. Petioles mostly 1–2 cm. long, slender, blades obtuse at apex..var. *ε. leptopoda*
  b. Petioles mostly less than 1 cm. long, or if longer then robust and margined or with blades subacuminate at apex.
    c. Leaf-blades mostly 4–8.5 cm. long.
      d. Leaf-blades acute or obtuse at apex.
        e. Leaf-blades membranaceous.
          f. Capsules 4 mm. tall..............................var. *ι. olokelensis*
          f. Capsules ±2.2 mm. tall............................var. *κ. Wilkesii*
        e. Leaf-blades more or less coriaceous.
          f. Leaf-blades more often obovate-oblong or oblanceolate-oblong, at base more often somewhat narrow and oblique.
            g. Principal leaves 4–5 cm. wide..................var. *β. waimeana*
            g. Principal leaves 1.5–2.5 cm. wide.................var. *θ. molesta*
          f. Leaf-blades not or only a few obovate, at base mostly rounded and equilateral, those of principal leaves 2–3 (more rarely –3.8) cm. wide..*E. Remyi*
      d. Leaf-blades moderately acuminate at apex.............var. *ζ. kahiliana*

c. Leaf-blades longer.
  d. Leaf petioles and midribs narrow.
    e. Leaves blunt or rounded at apex.
      f. Leaf-blades 6–10 cm. long and 2–4.7 cm. wide......var. ι. *olokelensis*
      f. Leaf-blades 11–15.5 cm. long and 5–7 cm. wide......var. δ. *Lydgatei*
    e. Leaves subacute to subacuminate at apex.
      f. Leaf-blades 7–14 cm. long and 3–5 cm. wide......var. η. *wahiawana*
      f. Leaf-blades 6–9 cm. long and 1.5–2.6 cm. wide......var. κ. *Wilkesii*
  d. Leaf petioles and midribs broad, margined............var. γ. *pteropoda*

Glabrous, probably an ascending or suberect shrub 1–2 m. tall; internodes of stem 0.5–2 cm. long, of slender lateral branches much shorter. Leaves slenderly petiolate with petiole about 3–8 mm. long; blade variously oblong, oblong-elliptic oval or seldom subrhombic-oblong, at obtuse apex somewhat pointed (not emarginate), at base mostly rounded and equilateral, very entire and irregularly revolute, subcoriaceous, subglossy, delicately and numerously penninerved with divaricate nerves, 5–6.5 (a few blades up to 8.5) cm. long and 2–3 (a few up to 3.8) cm. wide; stipular body triangular, about 1–1.5 mm. tall, leaving a basal finally whitish callosity. Peduncles slender, glabrate, 5–10 mm. long, monocephalous, axillary and terminal, solitary or 2 or 3 in a fascicle. Involucre campanulate, outwardly glabrous or glabrate, about 2.4 mm. tall; glands commonly 5, transversely ovate and more or less reniform, exappendiculate; lobes very minute, hirtous. Styles short, their branches short and thickish; capsule dark brown, cernuous on short (±1.5 mm.) glabrate stipe, glabrous, about 3 mm. tall, cocci carinate; seed (apparently submature) stramineous in color, tetragonal, carinate, about 2.1 mm. long, the faces conspicuously scrobiculate.

Type: Collected by *Jules Remy*, no. *598*, Oahu, 1851–1855 (Gray).

Distribution: Known only from Oahu, where apparently not collected since Remy's day.

Specimens examined: *Remy 598* (type, Gray: cotype, Paris).

Confusion has arisen in literature due to Horace Mann's publishing in 1867 *(loc. cit.)* what purported to be an original description of *Euphorbia Remyi* A. Gray, with Kauai cited

first (that is, before Oahu) for the habitat. We must note, however, that some five years previously Boissier *(loc. cit.)* had published *E. Remyi* A. Gray and cited Oahu first. In fact, Boissier listed two varieties, α. and β., and based variety α. directly upon *Remy 598* from Oahu. (For the var. β. see var. κ. *Wilkesii.)*

I have found no other specimens matching the Remy type and cotype (both now before me), and it may well be that the species proper is one of those probably numerous endemic Hawaiian species which have been exterminated within the past century. There are, however, various specimens from Kauai that fall into eleven more or less easily distinguishable varieties of *E. Remyi,* and these are treated below.

Euphorbia Remyi var. β. **waimeana** Sherff, Bot. Gaz. **97**. 584. 1936.

Leaves moderately more coriaceous and revolute, more often obovate-oblong, at base more often oblique and somewhat narrowed, blade commonly about 7–8.5 cm. long and 4–5 cm. wide. A single capitulum without fruit seen.

Type: Collected by *Charles N. Forbes,* no. *1043-K,* Kalalau Pali, Waimea Drainage Basin, west side, Kauai, July 3–August 18, 1917 (Field).

Distribution: Western Kauai.

Specimens examined: *Forbes 1043-K* (type, Field: cotypes, Berlin; Delessert; Field; Kew).

This may be the first of the two forms described by Hillebrand (Fl. Haw. Isls., p. 395. 1888) as having been collected by Knudsen in Waimea. Hillebrand described the stipules as low, triangular, and 1–1.5 lines long. This holds for the very few stipules still observable toward tips of branches on my type, but the stipules lower down are represented merely by the whitish interpetiolar callosities which are conspicuous in this species.

Euphorbia Remyi var. γ. **pteropoda** Sherff, Bot. Gaz. **97**: 585. 1936.

Leaves coarsely petiolate, the broad petiole margined and 6–

12 mm. long; blade widely elliptic-oblong, at times minutely emarginate, moderately revolute, subcoriaceous, 8–11 cm. long and 4–4.8 cm. wide.

Type: Collected by *Abbé Urbain Faurie,* no. *478,* alt. 800 m., Kauhao, Kauai, February, 1910 (Delessert).

Distribution: Northwesternmost Kauai.

Specimens examined: *Faurie 478* (type, Delessert: cotypes, Bishop; Paris).

A variety quite distinct from the species proper and the other varieties in its robust margined leaf petioles and wide leaf midribs. Only in var. *olokelensis* do the leaf petioles or midribs tend at all to simulate those of var. *pteropoda* and then only occasionally and only to a slight extent.

Euphorbia Remyi var. δ. **Lydgatei** Sherff, Bot. Gaz. **97**: 585. 1936.

Leaves slenderly petiolate, petiole 7–10 mm. long; blade oblong-obovate, at apex itself abruptly subacute, at base narrowed and oblique, weakly or scarcely revolute, membranaceous, 11–15.5 cm. long and 5–7 cm. wide, the veins evident.

Type: Collected by *Reverend J. M. Lydgate,* Pole Line Trail, Wailua Mountains, Kauai (Bishop).

Distribution: Eastern Kauai.

Specimens examined: *Lydgate,* Pole Line Trail, Wailua Mts., Kauai (type, Bishop).

Euphorbia Remyi var. ε. **leptopoda** Sherff, Bot. Gaz. **97**: 585. 1936.

Leaves slenderly petiolate, petiole obsoletely hispid and 8–22 mm. long; blade more often elliptic-oblong (rarely ovate-oblong or subrhomboidal-oblong), at apex obtuse and sometimes minutely emarginate, at base rounded or subcordate and more often oblique, not or very narrowly revolute, glossy, more often 9–13 cm. long and 3–4.5 (–5.3) cm. wide.

Type: Collected by *Charles N. Forbes,* no. *1095-K,* Halemanu, Kauai, July 3–August 18, 1917 (Bishop).

Distribution: Central to northwestern Kauai.

Specimens examined: *Otto Degener 8085,* Olokele Canyon, Kauai, July 3, 1926 (Degener, 2 sheets; Field); *Forbes 1095-K* (type, Bishop).

Euphorbia Remyi var. ζ. **kahiliana** Sherff, Bot. Gaz. **97**: 586. 1936 (where misprinted *kalihiana)*.

Leaves slenderly petiolate, petiole 3–6 mm. long; blade subrhomboidal-oblong, at apex commonly somewhat acuminate, at base often oblique and cuneate-rounded, membranaceous, lightly revolute, only 4–7 (more rarely –8.5) cm. long and 2–3.5 cm. wide, the veins obscure above.

Type: Collected by *Charles N. Forbes,* no. *10-K,* foot of Kahili, Kauai, July 8, 1909 (Field, 3 sheets).

Distribution: Southern Kauai.

Specimens examined: *Forbes 10-K* (type, Field, 3 sheets).

Euphorbia Remyi var. η. **wahiawana** Sherff, Bot. Gaz. **97**: 586. 1936.

Leaves slenderly petiolate, petiole 5–15 mm. long; blade now narrowly now widely oblong-obovate, often gradually narrowed to a more or less oblique base, at apex subacuminate, membranaceous, lightly revolute, 7–14 cm. long and 3–5 cm. wide.

Type: Collected by *Charles Noyes Forbes,* no. *177-K,* Wahiawa Mountains, Kauai, August, 1909 (Field).

Distribution: Known only from type locality in Wahiawa Mountains, southern Kauai.

Specimens examined: *Forbes 177-K* (type and cotype, Field); *Rev. John M. Lydgate,* Wahiawa Mts., Kauai (Bishop).

Euphorbia Remyi var. θ. **molesta.** (Pl. 2.)

Varietas nova. Folia numerosa (ramorum internodiis saepius circ. 4–8 mm. longis), petiolo tenui et 4–9 mm. longo; lamina oblanceolata, sensim ad basim inaequilateralem angustata, apice obtusa subacutave, plerumque emarginata, anguste revoluta, subcoriacea, 4–7 (raro –9) cm. longa et 1.5–2.5 cm. lata.

Leaves numerous (internodes of branches more often about 4–8 mm. long), petiole slender and 4–9 mm. long; blade oblanceolate, gradually narrowed to an oblique base, at apex obtuse or subacute, commonly emarginate, narrowly revolute, subcoriaceous, 4–7 (rarely –9) cm. long and 1.5–2.5 cm. wide.

Type: Collected by *Charles Noyes Forbes,* no. *224-K,* Wahiawa Mountains, Kauai, August, 1909 (Field, 2 sheets).

Distribution: Southern Kauai.

Specimens examined: *Forbes 224-K* (Field, 2 type sheets).

Treated in the herbarium by Forbes as a variety of *Euphorbia atrococca* Heller. That species, however, has the inflorescence distributed along delicate lateral branchlets, as in *E. multiformis,* while in our plants they are distributed upon the main woody branches themselves, as in the various varieties of *E. Remyi.*—The varietal name was given in allusion to the somewhat *burdensome* situation arising from having still another variety added to *E. Remyi.*

Euphorbia Remyi var. ι. **olokelensis** Skottsberg & Sherff *ex* Skottsb., Meddel. Göteb. Bot. Trädg. **10**: 121. (Febr. 7,) 1936 (without description); *ex* Sherff, Bot. Gaz. **97**: 586. (Apr. 2,) 1936 (with description).

Leaves narrowly or somewhat widely petiolate, petiole 4–12 mm. long; blade elliptic-oblong or subobovate-oblong, at the often oblique base now cuneate-narrowed now subcordate, at apex obtuse, membranaceous, scarcely or not revolute, 6–10 cm. long and 2–4.7 cm. wide.

Type: Collected by *Dr. Carl Skottsberg,* no. *1050,* innermost part of Olokele Valley, Kauai, October 31, 1922 (Bishop).

Distribution: Central to northwestern Kauai.

Specimens examined: *Charles N. Forbes 456-K,* Olokele Valley, Kauai, September, 1909 (Field); *Albert S. Hitchcock 15220,* alt. 1400 ft., Olokele Gulch, Kauai, October 18, 1916 (U. S.); *Joseph F. Rock 2078,* Halemanu, Kauai, February 14–26, 1909 (Bishop; Gray); *Rock 12936,* Kaholuamanu, Kauai, October, 1916 (Bishop); *Rock 17108,* same locality and date (Bishop); *Skottsberg 1037,* Olokele Canyon, Waimea, Kauai, October 31, 1922 (Gothenburg; juvenile and scarcely typical material); *Skottsberg 1050* (type, Bishop); *Dr. Heinrich Wawra 2086,* Kauai, *1868–1871* (Vienna, 2 sheets).

Rock 17108, which, although coming from Kaholuamanu, is so close to the Olokele specimens that it is not varietally separable, has a mature capsule measuring 4 mm. long, the cocci obtuse on the back. The specimens from the type locality proper are without mature capsules.

Euphorbia Remyi var. κ. **Wilkesii** Sherff, Bot. Gaz. **97**: 587. 1936.

Euphorbia Remyi var. β. Boiss. *in* DC., Prodr. **15**, pt. 2: 1262. 1862.

Leaves narrowly oblong, at base obliquely narrowed, at the subacute or acute apex rarely somewhat subacuminate, very membranaceous, not revolute, the slender petiole about 7–11 mm. long, the blade 6–9 cm. long and 1.5–2.6 cm. wide. Involucre 2 mm. tall. Capsule only about 2.2 mm. tall, cocci acutely carinate and not sulcate; seeds tetraquetrous, their sides scrobiculate; stipe much reflexed.

Type: Collected by the *United States Exploring Expedition,* Kauai, 1840 (U.S.).

Distribution: Kauai, exact part unknown.

Specimens examined: *U. S. Explor. Exped.,* Kauai, 1840 (type, U. S.).

Asa Gray supplied a description of his *Euphorbia Remyi* to Boissier, as is shown in Boissier's citation "A. Gray in litt." and the additional note, "Descr. ex cl. A. Gray in litt." Boissier published the description in 1862. As already stated (see p. 17), Boissier listed two varieties, α. and β., basing α. on *Remy 598, "absque fructu,"* from Oahu, and β. on the material collected by the United States Exploring Expedition (that is, the "Wilkes Expedition"), on Kauai. Gray's description of the species *E. Remyi* included the fruit. But since *Remy 598* was *"absque fructu"* (and this is confirmed by an examination of Gray's ample type specimen now before me), the fruit clearly must have been described from that in the packet of fragmentary but fruiting *U. S. Explor. Exped.* material which Gray had before him and from which (as stated on the label) he sent "a little to Boissier."

Shortly after Boissier's work was published, Horace Mann and William T. Brigham botanized in the Hawaiian Islands (May 4, 1864–May 18, 1865). They collected a specimen with larger, more acuminate leaves and with capsules 4 (not about 2.2) mm. long, the cocci obtuse (not acutely keeled) upon their backs. Asa Gray saw this material; his fragment of it, labeled *"Euphorbia Remyi* n. sp." in his own handwriting, is still pre-

served (Gray). He evidently at once revised his supposedly unpublished description of *E. Remyi* in an attempt to allow for the larger capsules, and Mann, in 1867 (Proc. Amer. Acad. **7**: 202; Enum. Haw. Pl., no. 438), published the description as revised. Thus we read: "Capsules small, acutely triangular-3-lobed, and glabrous (immature?), or much larger, 2 lines long, the cocci obtuse on the back." The two types of fruit and even of leaves are varietally incongruous, and I limit the variety *Wilkesii* to plants typified by the original Wilkes (small-fruited) material. (For further consideration of the *Mann & Brigham* plant, see variety μ. *hanaleiensis.)*

Euphorbia Remyi var. λ. **kauaiensis** Degener & Sherff *ex* Sherff, Bot. Gaz. **97**: 584. 1936.

Leaf petiole slender, 5–18 mm. long; blade elliptic-oblong or more rarely -lanceolate or subrhomboid-oblong, at apex subacute and very rarely emarginate, at the more or less oblique base cuneate-narrowed or rarely subrounded, subglossy, membranaceous, 8–15.5 cm. long and 3–5 cm. wide, penninerved (the lateral nerves divaricate, slender, manifest), very entire, not or very minutely and irregularly revolute. Inflorescence axillary and terminal, irregularly branched (nodules stipuliferous, often 2-budded), 1.5–4 cm. long, commonly 3–7-cephalous. Involucre when dry blackish or purplish-black, hemispherical, outwardly glabrate or toward top hispidulous, 3 mm. tall; glands commonly 5, transversely oblong, exappendiculate; lobes small, hirtous; pedicel slender, blackish, glabrate or sparsely setose (often irregularly and very minutely more or less slender-papillate), more often 7–10 mm. long. Capsule cylindric-ovate, subacutely trigonal, glabrous, shortly stipitate (stipe apparently always straight or nearly so), 3.5–4 mm. tall; styles distinct to the base, the short or very short lobes thickened. Seeds chestnut-colored, acutely tetragonal, at base truncate, at apex obtuse, on faces scrobiculate, about 2–2.2 mm. long.

Type: Collected by *Otto Degener*, no. *8093*, near Hanapepe Falls, Kauai, June 19, 1926 (Field).

Distribution: Southern Kauai.

Specimens examined: *Degener 8093* (type, New York; cotypes, Degener, 2 sheets; Field).

Euphorbia Remyi var. μ. **hanaleiensis** Sherff, Bot. Gaz. **97**: 588. 1936.

Leaves membranaceous, the slender petiole ±8 mm. long; blade broadly oblanceolate-oblong, at apex subacuminate, ±12.5 cm. long. Inflorescence very delicate, ±1.7 cm. long, branched, ±4-cephalous, the slender pedicels glabrous and 4–7 mm. long; involucre ±3 mm. across, tomentulose above; cocci densely tomentulose toward margins, about 4 mm. long; seeds tetragonal, scrobiculate, about 3 mm. long.

Type: Collected by *Horace Mann* and *William T. Brigham*, Hanalei, Kauai, 1864–1865 (Cornell).

Distribution: Northernmost Kauai.

Specimens examined: *Mann & Brigham*, Hanalei, Kauai, 1864–1865 (type, Cornell: cotype fragment, Gray).

5. **Euphorbia halemanui** Sherff, Bot. Gaz. **97**: 582. 1936. (Pl. 3.)

Chamaesyce halemanui (Sherff) Croiz. & Deg. *ex* Deg., Fl. Haw. Dec. 9, 1936.

Glabrous, probably a shrub 1–2 m. tall, internodes of branches commonly 0.5–1.5 cm. long. Leaves opposite, petiole slender and 5–10 mm. long; blade elliptically or sometimes subrhomboidally oblong or obovate, at apex obtuse and not emarginate, at base narrowed but scarcely oblique, at margins not or scarcely subrevolute, pinnately nerved (nerves divaricate, on upper surface often obscure), 4.5–8 cm. long and 2–3.3 cm. wide; stipular body triangular, scarious, 1–2 mm. tall, its upper margin fimbriate. Inflorescences axillary and terminal, contracted, globose, only 4–8 mm. tall, each of about 4–10 capitula. Involucre urceolate, outwardly glabrous, under 2 mm. tall; glands 4 or 5, transversely oblong, exappendiculate; pedicel minute, glabrous, under 3 mm. long; staminophores numerous, exserted. Capsule (submature) cernuous, very glabrous, trigonous, 2.2 mm. tall; cocci subacutely carinate; stipe glabrous, up to 3 mm. long; styles very distinct to the base, their short branches thickened.

Type: Collected by *Charles N. Forbes*, no. *1095-(a)K*, Halemanu, Kauai, July 3–August 18, 1917 (Bishop).

Distribution: Northwestern Kauai.

Specimens examined: *Forbes 943-K*, Halemanu, Kauai, July 3–August 18, 1917 (Bishop); *Forbes 1095-(a)K* (type, Bishop); *Dr. Carl Skottsberg 1002*, forest near Kokee Ranger Station, Kauai, October 28, 1922 (Bishop).

Noticeable for its minute globose very much contracted clusters of heads, a cluster usually measuring 4–7 mm. tall.

6. **Euphorbia Celastroides** Boissier *in* DC. Prodr. **15**, pt. 2: 11. 1862; Christoph. & Caum, Bishop Mus. Bull. no. 81: 6, *pl. 2-B*. 1931.

Euphorbia multiformis var. *Celastroides* A. Gray *ex* H. Mann, Proc. Amer. Acad. **7**: 202 (Enum. Haw. Pl., no. 439, var. ε.). 1867.

Chamaesyce Celastroides (Boiss.) Croiz. & Deg. *ex* Deg., Fl. Haw. Dec. 9, 1936.

a. Leaves mostly oval to obovate, commonly 1.5–3.5 cm. broad.
 b. Leaves mostly oval to subrhombic-oval; pedicel 1–3 mm. long.
  c. Leaves mostly subrhombic-oval, basally broad (4–8 mm.) and truncate-subcordate; plant of northeastern Molokai..........var. ε. *waikoluensis*
  c. Leaves rarely somewhat subrhomboidal, few basally broad or truncate-subcordate..........var. η. *kohalana*
 b. Leaves broadly to narrowly obovate.
  c. Many leaves indented once on each side near apex (with a resulting broad short terminal often emarginate lobe)..........var. β. *Stokesii*
  c. Leaves never (or in var. γ. *moomomiana* rarely) thus indented.
   d. Leaves very numerous and conspicuously imbricate-distichous, more often reflexed; capitula solitary or 2–5 on thickened and abbreviated axillary axis; plant of western Molokai and Kaula..........var. γ. *moomomiana*
   d. Leaves otherwise.
    e. Leaves thickish; plant of Nihoa, Niihau, and westernmost Kauai..........*E. Celastroides*
    e. Leaves thinner, at least when dry; plant of easternmost Kauai..........var. θ. *kealiana*
a. Leaves oval or obovate to linear, commonly less than 1.5 cm. wide (or if a few cauline leaves wider, then rameal leaves very numerous and branchlets prominently ridged and often with additional diminutive bracting leaves —var. ι. *halawana*).
 b. Involucral pedicels capillary, somewhat flexuous, becoming 1.5–1.8 cm. long..........var. μ. *nematopoda*
 b. Involucral pedicels (if present) stouter or shorter or both.
  c. Capitula in poly(±11)-cephalous cymes..........var. ο. *niuensis*

c. Capitula mostly 1–7 at a node.
d. Capitula usually many to a branchlet, each node of which may bear a short slender flowering axis in one axil.
e. Capitula mostly 1 to a node, pedicel ±13 mm. long..var. λ. *Humbertii*
e. Capitula (at least in well developed specimens) mostly in 2–7-cephalous cymes.
f. Cymes much contracted, their axis and branches thickish and nodose (and thus numerously stipulate-bracted), capitula sessile to subsessile................................var. δ. *kaenana*
f. Cymes open, the branches slender, capitula pedicelled.
g. Leaves noticeably divaricate (except for terminal 1 or 2 pairs, which are antrorse) and distichous, more or less falcate, often 5–7 cm. long..................................var. ν. *lorifolia*
g. Leaves directed variously, not or scarcely falcate, seldom more than 5 cm. long..........................var. ξ. *hanapepensis*
d. Capitula few to a branchlet.
e. Capitula sessile or subsessile (pedicel less than 2 mm. long).
f. Mature seeds mostly tetragonal, 1.7–2 mm. long.
g. Leaves mostly broad-obovate to almost rotund.
h. Leaves densely crowded, ultimate branches (unless in form *kahanana)* mostly short and thick like penultimate ones, involucres usually sessile, capsules glabrous or nearly so; plant of northeasternmost Molokai and (f. *kahanana)* eastern Oahu..................................var. ι. *halawana*
h. Leaves fewer, ultimate branches mostly slender (1–1.5 mm. thick) and thus abruptly unlike penultimate ones, involucres usually subsessile, capsules appressedly and more or less arachnosely whitish-hispid (finally glabrate at some places); plant of northwestern Hawaii........var. κ. *saxicola*
g. Leaves mostly oblanceolate or narrower........var. π. *amplectens*
f. Mature seeds mostly biconvex, 1.4–1.6 mm. long....var. ρ. *mauiensis*
e. Capitula all or many definitely slender-pedicellate (pedicel 4–7 mm. long)..var. ζ. *haupuana*

Shrub, glabrous, glaucous, spreadingly branched and often forming dense mats; branches rather closely but not widely nodose, often reddish. Leaves opposite and distichous, sometimes a few pairs imbricately crowded at tips of branches, the rather narrow petiole concave or channeled on upper surface and about 2–4 mm. long; blade spatulately cuneate-obovate to oblong-oblanceolate (often with one edge concave and one convex), obtuse to orbicular at apex but not or scarcely retuse, gradually narrowed below to a slender truncate-subcordate base, at margin entire and at times somewhat upturned, somewhat rigid, commonly 2.5–5.5 cm. long and 1–2.5 cm. wide, the

lateral veins more or less obscure on upper surface; stipules coalesced into a single interpetiolar body on each side, this very broad, short, more or less ciliate. Cymes axillary, 1–5-cephalous. Involucre hemispherical, many-flowered, glabrate outside unless at lobes, hirtous inside along lines running from the glands, about 2.3 mm. tall; glands 4 or 5, yellowish-brown when dry (or yellow on living specimens); transversely deltoid-oblong to suborbicular, exappendiculate; stamens exserted; pedicel slender, glabrous, usually becoming about 1 cm. long. Capsule subsessile, blackish or black, trigonal, depressed, about 2.5 mm. tall; cocci scarcely carinate; styles very short, bifurcate about one third the way into thickish apically capitate branches; seeds reddish-gray, obscurely 4-sided, ovate in side view, minutely scrobiculate, about 1.5 mm. long.

Type: Collected by *Jules Remy,* Niihau, 1851–1855 (Paris).

Distribution: Nihoa, Niihau, and western coast of Kauai.

Specimens examined: *Edwin H. Bryan, Jr. 6,* abundant patches on summit and a few plants on southeast point, Nihoa, June 14, 1923 (Bishop); *Edward L. Caum 64,* alt. ±100 m. and ±300 m., among rocks on edge of windswept cliffs, Nihoa, June 17, 1923 (Bishop); *Otto Degener 8090,* growing only on sand dunes in hot arid region, north of Barking Sands, Kauai, June 13, 1926 (Degener, 2 sheets; Field); *C. S. Judd 5,* alt. 140 m., steep rocky hillside, Nihoa, June 20, 1923 (Bishop); *John F. G. Stokes,* Kaali, Niihau, January, 1912 (Bishop).

Boissier omits the color of the capsules but these are found to be blackish or even black on the fruiting specimens examined (*Bryan 6* and *Degener 8090*).

Perhaps hybridizing, through one of its varieties, with *E. Hillebrandii* (*cf. Otto Degener, Kwan Park & Will Bush 8042,* moderately dry region, small gulch on south side of upper Makua Valley, Oahu, May 10, 1931 [Degener; New York]; *Albert F. Judd & Carl Skottsberg 366,* slope of Puu Kaala, Makaleha, Oahu, August 30, 1922 [Gothenburg]), and with *E. multiformis* var. *manoana* (*cf. Charles N. Forbes 2472-O,* ridges between Niu and Wailupe, Oahu, April 11, 1917 [Bishop]; *Otto Degener, Kwan Park, D. LeRoy Topping & Otto Swezey 8100,* top of ridge in open sunny woods, middle ridge of Niu Valley, Oahu, June 4, 1932 [Degener; Field, 2 sheets; N. Y.]).

Euphorbia Celastroides var. **β. Stokesii** (Forbes) Sherff, Bot. Gaz. **97**: 593. 1936.

Euphorbia Stokesii Forbes, Bishop Mus. Occas. Paps., **5**: 108, *pl. 1.* 1913.

Low prostrate shrub 6 dm. tall; branches slender and terminally subherbaceous somewhat as in *E. multiformis.* Leaves obovate, often emarginate (some having the terminal portion partly set off from rest by an additional indentation on each side), somewhat fleshy, bluish-green above, paler beneath, 3–4.2 cm. long and 2–2.8 cm. wide, moderately membranaceous when dry. Capitula solitary, axillary; pedicel 1–1.5 cm. long. Capsule glabrous, 3 mm. tall.

Type: Collected by *John F. G. Stokes,* near the beach at Kii, Niihau, January, 1912 (Bishop).

Distribution: Northeasternmost Niihau and northeastern Kauai.

Specimens examined: *Stokes,* near beach at Kii, Niihau, January, 1912 (cotype, Bishop); *Stokes,* near Kalihiwai, Kauai, February, 1916 (Bishop).

Characterized by its more slender branchlets, the often present low terminal foliar lobe (manifest because of the two additional emarginations), and by its greenish capsules. Connected with *E. Celastroides* too well, however, by the variety *moomomiana,* which unites, for example, the green capsules and, though only to a slight extent, the terminal leaf lobe (characters of var. *Stokesii)* with a robust branching habit and, though only to a slight extent, imbricately crowded leaves (characters of the species proper).

Euphorbia Celastroides var. γ. **moomomiana** Sherff, Bot. Gaz. **97**: 593. 1936. (Pl. 4.)

Much branched; branches reddish, thick, very densely leaved, internodes commonly 3–6 mm. thick and twice or thrice as long. Leaves conspicuously distichous and imbricate, more often reflexed; blade somewhat rigid, obovate, at apex rounded or truncate sometimes emarginate (rarely with an additional small sinus a few mm. to each side of the midrib's terminus), gradually narrowed to a minutely auriculate-cordate base, at margin entire and somewhat revolute, bluish-green, paler beneath, 3–4.8 cm. long and 1.8–2.8 cm. wide; stipular body marginally fimbriate-hispid, 1.5–3.2 mm. tall. Capitula solitary and axillary or 2–5 on thickened abbreviated axis arising from

an axil; pedicel glabrous, ±1 cm. long. Capsule about 2 mm. tall and almost 3 mm. thick.

Type: Collected by *Joseph F. Rock,* no. *14014,* Moomomi, Molokai, April, 1918 (Bishop, 3 sheets).

Distribution: Western Molokai and Kaula, islet off Niihau.

Specimens examined: *Edward L. Caum 10,* Kaula, islet off Niihau, August 17, 1932 (Bishop); *Otto Degener 8069,* forming 1 × 2-yard mass, in pure sand on leeward side of large dune, extremely dry region, Moomomi, Molokai, April 25, 1928 (Degener, 2 sheets; Field; New York); *George C. Munro 494,* Moomomi sand hills, Molokai, July 26, 1922 (Bishop); *Rock 14014* (3 type sheets, Bishop).

The *Munro* plant appears to have been regarded as new by Rock, but at the Bishop Museum both the *Munro* and the *Rock* plants had been referred to the deceptively similar *Euphorbia Stokesii* (my variety *Stokesii).* The latter plant differs strongly, however, in having: rameal internodes much shorter and thicker; the much more numerous leaves so close that in the herbarium specimens they present a highly imbricated effect, their blade only very rarely with an indentation on each side of and a few millimeters from the midnerve's distal end; the tendency to bear thickened abbreviated axillary branches which are mere axes to hold the capitula; the shorter capsule, etc.

Euphorbia Celastroides var. δ. **kaenana** Sherff, Bot. Gaz. **97**: 594. 1936. (Pl. 5.)

Shrub with thick very nodose branches, bark often whitish-gray and, when dry, lengthwise much wrinkled. Leaves somewhat clustered over distal third or half of the much reduced thickish (2–4 mm.) ultimate branchlets, lower ones often reflexed; petiole slender, glabrous, 2–3 mm. long; blade broadly to narrowly oblong-oblanceolate, at apex obtuse to truncate-subemarginate, cuneately or subcuneately narrowed below to an oblique and truncate-subcordate base (this 3–5 mm. wide), pale green, thin, mostly 3–4.5 cm. long and 1–1.6 cm. wide. Cymes much contracted, their axis and branches thickish and nodose (the numerous stipular bracts very obvious); capitula often 5–7, sessile to subsessile; involucre outwardly glabrate or minutely setulose except for the hirsute lobes. Capsule sub-

sessile, glabrate, drying blackish, about 2.5 mm. tall; seeds grayish over red undercoat, biconvex-tetragonal, scrobiculate, obliquely tetragonal at each end, 1.2–1.4 mm. long.

Type: Collected by *Vaughan MacCaughey*, Kaena uplands, Oahu, March 28, 1915 (Bishop).

Distribution: Northwesternmost Oahu.

Specimens examined: *Otto Degener, W. Hirai,* and *Kwan Kee Park 8038*, among rocks in arid region, near Kaena Point, Oahu, March 21, 1931 (Degener; Field; New York); *Charles N. Forbes 1654-O*, between Makua Valley and Kaena Point, Oahu, February 25, 1911 (Field); *Forbes* (with *Dean Lake) 2280-O*, talus slopes, Kaena Point, Oahu, December 16, 1915 (Bishop); *MacCaughey*, Kaena uplands, Oahu, March 28, 1915 (type, Bishop).

Euphorbia Celastroides var. ε. **waikoluensis** Sherff, Bot. Gaz. **97**: 594. 1936.

Shrub with moderately slender reddish branches. Leaves moderately numerous but seldom imbricate, pale or glaucescent, the dark and minutely puberulous petiole only about 1–2 mm. long; blade subrhombic-oval, apically obtuse to rounded and sometimes slightly emarginate, basally broad (4–8 mm.) and truncate-subcordate, commonly 2.5–3.8 cm. long and 1.5–2.5 cm. wide. Capitula (only a few seen) solitary or subsolitary, axillary or terminal, the involucre pubescent especially above; pedicel short (1–3 mm.). Capsule (a single immature one seen) black.

Type: Collected by *Joseph F. Rock*, no. *6191*, on beach of Waikolu, Molokai (Field).

Distribution: Northeastern Molokai.

Specimens examined: *Rock 6191* (type, Field: cotype, Field).

Euphorbia Celastroides var. ζ. **haupuana** Sherff, Bot. Gaz. **97**: 594. 1936.

Doubtless a shrub; the woody branches slender, grayish-black, the ultimate ones numerously and conspicuously nodose (their internodes mostly 3–7 mm. long and 1–2.5 mm. thick). Leaves as in species proper and somewhat crowded at ends of branches but smaller (blade commonly under 3 cm. long and 2 cm. wide) and at apex commonly obtuse very rarely retuse. Capitula usually not more than 1 or 2 at a node, the slender

glabrous pedicel 4–7 mm. long. A single very immature capsule observed, this black.

Type: Collected by *Joseph F. Rock*, no. *2444*, Haupu-Lihue, Kauai, March 18, 1909 (Bishop).

Distribution: Southeastern Kauai.

Specimens examined: *Charles N. Forbes 20-K pro parte*, near Lihue, Kauai, July 9, 1909 (Field); *Forbes 600-K*, Nonou Mountains, Kauai, October 16–17, 1916 (Field); *Rock 2444* (type, Bishop: cotype, Gray).

Euphorbia Celastroides var. *η*. **kohalana** Degener & Sherff *ex* Sherff, Bot. Gaz. **97**: 595. 1936.

A shrub of open branching habit; the reddish branches slender and with long internodes (often 2–4 cm.), the nodes inconspicuous; ultimate branches very slender (±1 mm. thick), moderately leafy and often bearing 1 or 2 very short-pedicellate (1–3 mm.) capitula at the tip and at 1 or 2 nodes. Leaves more narrowly petiolate; the blade from oval to obovate (rarely somewhat subrhomboidal), at apex rounded to emarginate, bluish-green or glaucescent, at the more or less oblique base narrowly or widely rounded to truncate-subcordate, 2.5–4 cm. long and 1.5–2.5 cm. wide.

Type: Collected by *Otto Degener*, no. *8037*, Kohala, Hawaii, March 22, 1930 (Delessert).

Distribution: Northwestern Hawaii.

Specimens examined: *Degener 8037* (type, Delessert: cotypes, Field, 2 sheets; New York); *Rock 14032*, without data (Bishop; a specimen without flowers or fruits and with the leaves mostly less blunt or rounded at apex).

Euphorbia Celastroides var. *θ*. **kealiana** Sherff, Bot. Gaz. **97**: 595. 1936.

Doubtless a shrub and more or less matting; branches blackish, nodes numerous and conspicuous, internodes now 3–7 mm. now ±1 cm. long and ±3 mm. (or for ultimate branches 1–1.5 mm.) thick. Leaves as in species proper but drying thinner, blade becoming 5 cm. long and 3.3 cm. wide, probably somewhat differently colored. Capitula not seen.

Type: Collected by *Abbé Urbain Faurie*, no. *477*, on rocks of the shore at Kealia, Kauai, January, 1910 (British).

Distribution: Southeastern Kauai.

Specimens examined: *Faurie 477* (type, British: cotype, Paris); *Charles N. Forbes 20-K pro parte*, near Lihue, Kauai, July 9, 1909 (Field).

Euphorbia Celastroides var. ι. **halawana** Sherff, Bot. Gaz. **97**: 596. 1936. (Pl. 6.)

A much-branched and very leafy shrub, doubtless often forming mats; the ultimate and subultimate reddish branches lengthwise much wrinkled and ridged at least when dry, their internodes mostly 1–2 mm. thick. Leaves more persistent on branchlets than in species proper and foregoing varieties, with a brownish tinge when dry, averaging much smaller; petiole slender, 1–2 (rarely –3) mm. long; blade variously oval-obovate, subrhombic-obovate, or suborbicular, at apex rounded to truncate-emarginate, at the oblique and usually widish base rounded to truncate-subcordate, for a few cauline leaves up to 3.5 cm. long and 2 cm. wide but for the multitude of rameal smaller ones mostly 1–2.5 cm. long and 0.8–2 cm. wide (or *for the minute often numerous leaves subtending capitula* down to ±4 mm. long and to ±4 mm. wide). Capitula subsessile, usually solitary, often borne at and near tip of diminutive leafy-bracted lateral branchlet; involucre outwardly tomentose at least above. Capsule glabrous or slightly pubescent, greenish-brown, sessile or apparently so, ±3 mm. tall; seeds grayish, scrobiculate, 2 mm. long.

Type: Collected by *Joseph F. Rock*, no. *14041*, near Halawa, Molokai, April, 1918 (Bishop).

Distribution: Northeasternmost Molokai.

Specimens examined: *Otto Degener 8054*, dry coastal cliffs, west side of Halawa Valley, Molokai, June 20, 1928 (Field, 2 sheets); *Abbé Urbain Faurie 472*, on shore at Halawa, Molokai, June, 1909 (British; Paris); *Rock 14041* (type, Bishop: cotype, Bishop).

Euphorbia Celastroides var. **halawana** f. 1. **kahanana** Sherff, Bot. Gaz. **97**: 596. 1936.

Branchlets less roughened or ribbed when dry, leaves more numerous, inflorescences more often subtended with very small leaves.

Type: Collected by *Otto Degener*, no. 8036, on sunny ridge, west slope of Kahana Valley, Oahu, February 26, 1929 (Degener).

Distribution: Known only from type locality on Oahu.

Specimens examined: *Degener 8036* (type, Degener; cotypes, Field; N. Y.).

Euphorbia Celastroides var. κ. **saxicola** Degener & Sherff *ex* Sherff, Bot. Gaz. **97**: 596. 1936.

Euphorbia oahuensis Skottsberg, Meddel. Göteb. Bot. Trädg. **10**: 122. 1936 *(ex syn.* Hillebr. but excluding Skottsberg's plant).

Somewhat resembling the variety *halawana* in habit. Leaves averaging slightly smaller and more often obovate, with apex emarginate. Involucre commonly with a short (1–4 mm.) but manifest pedicel. Capsule (sessile) drying brownish-black to black.

Type: Collected by *Otto Degener,* no. 8088, along rocky shore, Kohala, Hawaii, August 9, 1926 (Delessert).

Distribution: Northwestern Hawaii and southeastern Oahu.

Specimens examined: *Degener 8088* (type, Delessert: cotypes, Degener, 2 sheets; Field); *Dr. William Hillebrand,* Kailua, Oahu (Berlin; type of *Euphorbia oahuensis* Skottsberg).

Euphorbia Celastroides var. λ. **Humbertii** Sherff, Bot. Gaz. **97**: 596. 1936.

Probably a shrub; branches ascending, slender, ultimate ones mostly 1–1.6 mm. thick at internodes (these more often 3–9 mm. long), nodes conspicuous. Leaves moderately crowded on distal third or half of each branchlet, the slender petiole 2–4 mm. long; blade cuneately and often subfalcately oblanceolate, apically obtuse to truncate or rounded but seldom retuse, basally oblique-truncate and only about 1.5–3 mm. wide, bluish-green or glaucescent, thinnish, commonly 2–4 cm. long and 0.7–1.5 cm. wide. Capitula abundant but usually only 1 or 2 at a node, mostly elongate-pedicellate; involucre outwardly glabrate, pedicel slender, rigid, suberect, and finally ±13 mm. long. Capsule glabrous, sessile or apparently so, ripening brownish-black, about 2.5 mm. tall.

Type: Collected by *Jules Remy,* no. *595,* Kauai, 1851–1855 (Gray).

Distribution: Oahu and Kauai.

Specimens examined: *Thomas Nuttall*, Parri ("probably Nuuanu Pali"), Oahu (Kew; type material of *Euphorbia annulata* Nutt. ined.); *Remy 595* (type, Gray: cotypes, Paris, 2 sheets); *U. S. Explor. Exped.*, Oahu, 1840 (Gray; Missouri; U. S.).

Named for Professor H. Humbert of Paris, without whose invaluable assistance my treatments of this and several other members of the genus *Euphorbia* would have been greatly handicapped if not precluded.

Euphorbia Celastroides var. μ. **nematopoda** Sherff, Bot. Gaz. **97**: 597. 1936.

Similar to var. *Humbertii.* Differs in its less crowded leaves, fewer capitula, these on more flexuous, not rigid and suberect, even more delicate, and a third to a half longer pedicels.

Type: Collected by *Charles N. Forbes,* no. *726-K,* at left-hand side of Kipu Kai Gap, Haupu Range, Kauai, November 1, 1916 (Bishop).

Distribution: Known only from type locality in southeastern Kauai.

Specimens examined: *Forbes 726-K* (type, Bishop).

Euphorbia Celastroides var. ν. **lorifolia** (A. Gray) Sherff, Bot. Gaz. **97**: 597. 1936.

Euphorbia multiformis var. *lorifolia* A. Gray *ex* H. Mann, Proc. Amer. Acad. **7**: 202 (Enum. Haw. Pl., no. 439, var. δ.). 1867.

Euphorbia lorifolia Hillebrand, Fl. Haw. Isls., p. 395. 1888, only as to syn. A. Gray.

Euphorbia rivularis Heller, Minn. Bot. Studs. **1**: 846, *pl. 51.* 1897.

Chamaesyce lorifolia (A. Gray) Croiz. & Deg. *ex* Deg., Fl. Haw. Dec. 9, 1936 *(ex syn. Hillebr. quoad Hillebr. syn. A. Grayi utitur).*

A shrub 1.5–1.8 m. tall, simple below with a stem ±2.5 cm. thick; branches loose, spreading. Differs from variety *Humbertii* in its more conspicuously distichous, more elongate, more often falcate leaves, these often 7 cm. long; also in its commonly more compound inflorescence (often with 3–5-cephalous cymes) and shorter pedicels, these latter mostly ±5 mm.

long. Seeds tetragonal, grayish over red undercoat, distinctly scrobiculate.

Type: Collected by the *United States Exploring Expedition,* Kauai, 1840 (U. S.).

Specimens examined: *Anon.*, Kauai (Bishop, fragment *ex* Berlin); *anon. 415,* near Waimea Canyon, Kauai, June 29, 1928 (Field); *Brodie 4036,* Kauai (Field); *Otto Degener H-212,* near rain forest along irrigation ditch road, Olokele Canyon, Kauai, September 9, 1922 (New York); *Degener 8086,* Olokele Canyon, Kauai, July 3, 1926 (Degener, 3 sheets; Field); *Degener 8091,* rather dry region, northeast of Kipu, Kauai, June 17, 1926 (Degener, 3 sheets; Field); *Degener 8092,* near Hanapepe Falls, Kauai, June 19, 1926 (Degener, 2 sheets; Field; New York); *Abbé Urbain Faurie 465,* Waimea, Kauai, March, 1910 (Paris); *Faurie 466,* Naapali, Kauai, January, 1910 (British; Paris); *Charles N. Forbes,* Olokele Valley, Kauai, September, 1909 (Bishop); *Forbes 944-K,* Halemanu, Kauai, July 3–August 18, 1917 (Field, 2 sheets); *Amos Arthur Heller,* on Kaholuamanu, above Waimea, Kauai, September 2–9, 1895 (Field); *Heller 2441,* on the Hanapepe and Wahiawa Watershed, Kauai, June 25, 1895 (Kew); *Heller* (similarly) *2441,* along the Hanapepe River, near the Falls, Kauai, June 24–26, 1895 (cotypes of *Euphorbia rivularis* Heller, Cornell; Field, 3 sheets; Gray; New York; Paris); *Heller* (similarly) *2441,* same locality, July 2–8, 1895 (Missouri); *Dr. William Hillebrand,* Hawaiian Isls. (Gray; Kew); *Albert S. Hitchcock 15251,* alt. 1400 ft., Olokele Gulch, Kauai, October 18, 1916 (U. S.); *Knudsen,* Kauai (Berlin); *Archibald Menzies,* Hawaiian Isls. (Kew); *Joseph F. Rock 2080,* Halemanu, Kauai, February 14–26, 1909 (Bishop; Gray; New York); *Rock 5564,* Kaholuamanu, Kauai, September, 1909 (Bishop; Gray; New York; Vienna); *Rock 12938,* same locality, October, 1916 (Bishop); *Rock 17257,* Hawaiian Isls. (Bishop); *Carl Skottsberg 1001,* in the forest near Kokee station, Kauai, October 28, 1922 (Bishop); *U. S. Explor. Exped.,* Kauai, 1840 (type, U. S.: type fragments, Gray; Missouri).

The leaves tend to stand "at right angles to the branch, except the ultimate ones, which extend forward" (Heller, *loc. cit.).*

Our concept for the variety *lorifolia* must rest directly upon Asa Gray's manuscript description published by Horace Mann (and its underlying type plant collected by the United States Exploring Expedition): "Var. δ *lorifolia* (Gray, *l. c.* ined.): foliis lineari-elongatis (bipollicaribus) crassis; pedicellis involucro 2–4-plo longioribus."

Mann erroneously referred *Mann & Brigham 389* to the variety *lorifolia,* and subsequent botanists, beginning with Hillebrand, seem uniformly to have rested their concept for *lorifolia* upon the *Mann & Brigham* plant. We may note, however, that that very keen student of Euphorbiaceae, Dr. George Engel-

mann, made a carefully detailed study of a fragment of the type of variety *lorifolia,* and that his extended description, in pencil, is on a slip attached to his private herbarium sheet (Missouri). He studied also *Mann & Brigham 389* and wrote: "seed different from *lorifolia* and very distinct."

The *Mann & Brigham* plant is referred by me to variety *mauiensis.* The true variety *lorifolia* is seen to be the plant described by Heller *(loc. cit.)* as *Euphorbia rivularis.*

Euphorbia Celastroides var. ξ. **hanapepensis** Sherff, Bot. Gaz. **97**: 597. 1936. (Pl. 7.)

Euphorbia Celastroides Heller, Minn. Bot. Studs. **1**: 844. 1897 (not Boiss.).

A small tree with short trunk, loosely branching; the smaller or younger branches stiff and with short (commonly 5–12 mm.) internodes, brownish-black or grayish-black at least when dry. Leaves somewhat crowded toward tips of branchlets, petiole slender and 1–4 mm. long; blade linear-oblanceolate to broadly oblanceolate, at apex rounded to subobtuse, at base narrow (usually less than 3 mm. wide), thinner and more greenish above than in species proper and somewhat yellowish-silvery beneath, 2–5 cm. long and 0.7–1.7 cm. wide. Capitula much more numerous than in species proper, solitary at the nodes or more often in 2–5-cephalous cymes (these in axils of abbreviated leafy lateral branchlets); involucre outwardly glabrous; pedicel slender, glabrous, 3–8 mm. long. Capsule glabrous, drying dark brown, sessile or apparently so; seeds grayish, scrobiculate.

Type: Collected by *Amos Arthur Heller,* no. *2429,* along the Hanapepe River, near the Falls, Kauai, July 2–8, 1895 (Missouri).

Distribution: Southeastern Kauai.

Specimens examined: *Abbé Urbain Faurie 476,* on rocks, Hanamaulu, Kauai, December, 1909 (Bishop; Delessert; Paris); *Heller 2429,* along the Hanapepe River, near the Falls, Kauai, June 24–26, 1895 (Cornell; Field, 2 sheets; Gray; New York; Paris); *Heller* (similarly) *2429,* on the Hanapepe and Wahiawa Watershed, Kauai, June 24, 1895 (Kew); *Heller* (similarly) *2429,* along the Hanapepe River, near the Falls, July 2–8, 1895 (type, Missouri: cotype, U. S.).

A form which might be taken for a distinct species if it were not connected with the species proper by such a complete series of intermediate varieties.

Euphorbia Celastroides var. *o.* **niuensis** Sherff, Bot. Gaz. **97:** 598. 1936.

Similar to var. *lorifolia.* Leaf petioles slender, glabrate, 2–3 mm. long; blade oblong, at apex obtuse or rounded, at base oblique-truncate and 3–5 mm. wide, glaucescent, thinnish, ±2.5 cm. long and ±1.2 cm. wide. Capitula ±11 in tiny cymes (these ±1.5 cm. long, the branches spreading or recurved; pedicels slender but short, commonly 1–4 mm. long). Capsules drying dark brown, glabrous, sessile or apparently so, about 2 mm. tall. Seeds grayish over red undercoat, tetragonal, only about 1–1.1 mm. long, only moderately or even indistinctly scrobiculate.

Type: Collected by *Dr. William Hillebrand,* Niu, Oahu (Berlin).

Distribution: Southeastern Oahu.

Specimens examined: *Hillebrand,* Niu, Oahu (type, Berlin).

Perhaps now extinct. The type is a mere fragment but very distinctive. It is the specimen referred to by Hillebrand (Fl. Haw. Isls., p. 395. 1888) for Oahu material of *Euphorbia Celastroides.* I have found no other material to match it.

Euphorbia Celastroides var. *π.* **amplectens** Sherff, Bot. Gaz. **97:** 598. 1936. (Pl. 8.)

Euphorbia lorifolia Hillebr., Fl. Haw. Isls., p. 395. 1888 (in small part and excluding syns. A. Gray and DC.; *cf.* var. *mauiensis).*

Now a prostrate or erect shrub, now arborescent, much branched; ultimate and penultimate branches grayish-black, puberulous, not strongly ridged, the numerous nodes conspicuous, internodes mostly 1–2 mm. thick. Leaves of various aspects, but mostly with short (1–3 mm.) slender commonly pubescent petiole; blade mostly elliptic-oval to narrowly oblanceolate, at apex truncate and perhaps emarginate to rounded or obtuse, at base rounded or narrowed, with a more or less

brownish tinge to the green when dry, at times puberulous beneath toward petiole, mostly 1.5–3 cm. but sometimes to 6 cm. long. Capitula usually solitary, subsessile; involucre outwardly glabrous or glabrate below, often pubescent to conspicuously tomentose above. Capsule glabrous to moderately puberulous, sessile or apparently so, drying brownish-green to dark brown, about 3 mm. tall. Seeds now definitely tetragonal, now compressed and 2-edged except at the tetragonal truncate base, apically obtuse, grayish (over the red undercoat), scrobiculate, 1.7–2 mm. long.

Type: Collected by *Charles N. Forbes*, no. *355-Mo*, Kaluaaha Valley, Molokai, August, 1912 (Field).

Distribution: Kauai, Oahu, Molokai, Lanai, Maui, and Hawaii.

Specimens examined: *Anon. 375*, shrub about 4–6 ft. tall, Pololu Gulch, Kohala, Hawaii (Field); *Otto Degener 8043*, windswept ridge at beginning of forest, east ridge of Niu Valley, Oahu, April 20, 1931 (Degener; Field; New York); *Degener 8055*, growing 3.5–5 ft. tall, with *Santalum*, Mokomoko Gulch, Molokai, June 7, 1928 (Degener); *Degener 8057*, shrub 3 ft. tall, growing with *Lipochaeta Degeneri* in hot boulder-strewn region not far from ocean, near Kamakaipo, Molokai, May 16, 1928 (Degener); *Degener 8058*, on moderately dry rocky slope, growing with *Exocarpus*, Kahuaawi Gulch, Molokai, May 12, 1928 (Degener; Field; New York); *Degener 8060*, East Ohia ridge, Molokai, July 17, 1928 (Degener; Field; New York); *Degener 8062*, one of the dry valleys between Kamalo and Kaunakakai, Molokai, July 29, 1928 (Degener; Field; New York); *Degener 8070*, Moomomi, Molokai, April 25, 1928 (Degener); *Degener 8076*, dry rocky region, Kaupo Gap, Haleakala, Maui, August 20, 1927 (Degener; New York); *Degener 8077*, northwest of Puu Eke, Maui, August 31, 1927 (Degener, 2 sheets; Field; New York); *Degener 8078*, arid rocky region, Ulupalakua, Maui, June 23, 1927 (Degener, 2 sheets; Field; New York); *Degener 8087*, arid *aa* lava desert, Hoopuloa, Hawaii, August 26, 1926 (Degener, 3 sheets; Field); *Degener 8089*, in tapestry forest, Kohala ditch trail, Kohala, Hawaii, August 10, 1926 (Degener, 3 sheets; Field); *Degener & Kwan Kee Park 8045*, in arid rocky sunny region, second ridge east of Kuliouou Valley, near summit (ridge on west side of Kamehameha Farm School), Oahu, October 25, 1931 (Degener, 2 sheets; Field); *David Douglas 13*, Hawaiian Isls., 1834 (Kew, 2 sheets); *Frederick Eschscholtz*, Oahu, 1816–1817 (Kew; form with leaves closely approaching those in *E. multiformis*); *Abbé Urbain Faurie 471*, on rocks, Yao Valley, Maui, August, 1909 (British; Paris); *Charles N. Forbes 17-Mo*, Kalehu, Molokai, June, 1912 (Bishop); *Forbes 43-L*, mountains near Koele, Lanai, June, 1913 (Field, 2 sheets); *Forbes 93-M*, Iao Valley, West Maui, June, 1910 (Field); *Forbes 255-L*, Limestone Point, Lanai, December 13, 1913 (Bishop); *Forbes 273-M*, beach at Kipahulu, East Maui, July, 1910 (Bishop); *Forbes 314-L*, Lanai, September, 1917 (Field); *Forbes 355-Mo* (type, Field: cotypes, Field; Missouri); *Forbes 358-H*,

Kanahaha, Kona, Hawaii, July 25, 1911 (Bishop); *Forbes 480-M*, Honokohau Drainage Basin, Maui, September 25–October 17, 1917 (Field); *Forbes 533-Mo*, Halawa, Molokai, September, 1912 (Field); *Forbes 1511-O*, Koko Head, Oahu, June 11, 1909 (Bishop); *Forbes 1666-O*, Puu-O-Kona, Oahu, March 14, 1911 (Field); *Forbes 1775-M*, Kaapahu, Maui, December 9, 1919 (Bishop); *Forbes 1877-M*, Nuu, south slope of Haleakala, Maui, March 6, 1920 (Field); *Forbes 1913-M*, same locality, March 9, 1920 (Field); *Forbes 2386-M*, Olowalu Valley, Maui, May 16, 1920 (Field); *Forbes 2529-O*, Wailupe, Oahu, January, 1919 (Bishop); *Charles Gaudichaud*, Hawaiian Isls. (Missouri, fragment *ex herb.* Delessert); *Dr. William Hillebrand*, Molokai, June 21 (Berlin; labeled *Euphorbia lorifolia* by Hillebrand); *Hillebrand 48*, Hawaii (Kew); *Albert S. Hitchcock 14484*, shrub or small tree on lava flow, Puuwaawaa, Hawaii, August 30, 1916 (Bishop; U. S.); *James Macrae*, Maui, May, 1825 (Missouri); fragment *ex herb. Kunthii; Macrae*, Oahu, May 20, 1825 (New York); *Horace Mann & William T. Brigham 101 pro parte*, Oahu, 1864–1865 (Field); *Mann & Brigham 427*, ridge east of Nuuanu Valley, Oahu, 1864–1865 (Bishop); *Maximowitsch 145*, Honolulu, Oahu (Berlin; Kew); *George C. Munro 45*, outer forest, Kaiholena, Lanai, August, 1913 (Bishop); *Munro 97*, Limestone point, Lanai, December 13, 1913 (Bishop); *Munro 705*, alt. about 1000 ft., Ulukolea, Mahana, north side of Lanai, September, 1925 (Bishop); *Munro 828*, alt. 1100 ft., Maunalei Valley, Lanai, August 5, 1930 (Bishop); *Jules Remy 592*, tree, forest of Kekaha, Hawaii, 1851–1855 (Paris); *Joseph F. Rock*, Hawaiian Isls. (Field, 2 sheets); *Rock*, Honokohau Valley, Maui (Bishop); *Rock 8068*, Hawaiian Isls. (Field); *Rock 8126*, Koele, Lanai, August 3, 1910 (Gray); *Rock 8359*, Hawaiian Isls. (Field); *Rock 8677*, East Maui (Field); *Rock 8679*, East Maui (Field); *Rock 17036*, prostrate, near the ocean, Barbers Point, Oahu, November, 1919 (Bishop, 2 sheets; Gray); *Carl Skottsberg 1953*, along road between Lind's and Puuwaawaa, Hawaii, September 26, 1926 (Bishop); *John F. G. Stokes*, Molokai, 1909 (Bishop); *D. LeRoy Topping* (Otto Degener distrib. no.) *8075*, Maui, August 5, 1927 (Degener; Field, 2 sheets; New York, 2 sheets); *Dr. Heinrich Wawra 1852*, Maui, 1868–1871 (Vienna, 2 sheets).

Similar to and apparently passing by many intergradations into the variety *mauiensis*, but with leaves tending to be more often obovate and less often linear, and with seeds commonly larger (1.7–2 mm., not 1.4–1.6 mm. long) and usually tetragonal (only rarely — for example, *Rock 17036* — obcompressed). Plants perhaps not averaging as tall as in variety *mauiensis*, but some of the specimens included here are from plants ±3.6 m. tall (for example, *Forbes 358-H*, "slender, 12 ft., drooping branches").

Apparently includes several forms or races (hence the name *amplectens)*.

Euphorbia Celastroides var. ρ. **mauiensis** Sherff, Bot. Gaz. **97**: 601. 1936.

Euphorbia lorifolia Hillebr., Fl. Haw. Isls. 395. 1888 (in great part and exclud. syns. A. Gray and DC.; *cf.* var. *amplectens).*[1]

A shrub at lower altitudes to a small tree (3–6 m. tall and with trunk 1.5–2 dm. thick) in the upper regions, the stiff branches puberulous and nodose with short internodes. Leaves with short (1–2 mm.) puberulous petiole; blade linear to linear-oblong or rhombic-linear, apically obtuse to truncate and often retuse, basally somewhat contracted also subtruncate and oblique, glabrous or beneath especially toward base somewhat puberulous, 3–5 (less often to 7 or even to 9.5) cm. long, with a more or less brownish-green color when dry, the lateral veins ventrally dark and distinct. Capitula mostly solitary, sessile or subsessile; involucre outwardly pubescent. Capsule puberulous, subsessile, deeply 3-parted, drying brownish-green to dark brown, ±2.7 mm. tall. Seeds now obcompressed-tetragonal (two of the edges at times reduced to mere median ribs), now distinctly obcompressed and laterally 2-edged except at the tetragonal and truncate base, at apex shallowly rounded, brownish-gray to metallic-brown, scrobiculate, 1.4–1.6 mm. long.

Type: Collected by *Horace Mann & William T. Brigham,* no. *389,* on sandy isthmus of Maui, 1864–1865 (U. S.).

Distribution: Lanai and Maui.

Specimens examined: *Anon.,* Maui (Bishop, fragment *ex* Berlin); *Otto Degener 8074,* barren arid hill, *mauka* of *McGregor,* West Maui, July 10, 1927 (Degener; New York); *Abbé Urbain Faurie 474,* alt. 1500 m., Haleakala, Maui, August, 1909 (Paris); *Charles N. Forbes 115-L,* mountains near Koele, Lanai, June, 1913 (Bishop); *Forbes 139-L,* same locality and date (Field); *Forbes 223-L,* mountains at east end of Lanai, same date (Bishop; Field); *Forbes 366-L,* Kaiholena, Lanai, September, 1917 (Field, 2 sheets); *Forbes 1104-M,* Kaupo Gap, Haleakala Crater, Maui, August 10, 1919 (Field); *Forbes 1811-M,* Kanaio, south slope of Haleakala, Maui, March 2, 1920 (Bishop); *Forbes 1812-M,* same locality and date (Field); *Forbes 2048-M,* Auwahi, south slope of Haleakala, Maui, March 20, 1920 (Field);

[1] Croizat & Degener (*ex* Deg., Fl. Haw. Dec. 9, 1936) give the new combination "*C. lorifolia* (Hillebr.) Croiz. & Deg." and cite "*E. lorifolia* Hilleb., Fl. Haw. Isls. 395. 1888" as their synonym. Of course this treatment is wholly ineffective under the International Rules of Nomenclature, so far as renaming Hillebrand's own plants (my var. *mauiensis)* is concerned. In actual effect, Croizat & Degener have made a new combination, though evidently not meaning to do so, for *Euphorbia multiformis* var. *lorifolia* A. Gray (*qu. vide,* p. 33).

Forbes 2091-M, Auwahi, south slope of Haleakala, Maui, March 24, 1920 (Field); *Forbes & C. Montague Cooke, Jr., 1-M*, Maunahooma, West Maui, May, 1910 (Bishop); *Dr. William Hillebrand 45*, small tree 15–20 ft. tall, Kula, East Maui, July, 1858 (Kew, 2 sheets); *Hillebrand & Rev. J. M. Lydgate*, Hawaiian Isls. (Bishop); *Dr. Albert S. Hitchcock 14809*, alt. 3000–5000 ft., Puu Kukui, West Maui, September 24–26, 1916 (Bishop; U. S.); *Horace Mann & William T. Brigham 389* (type, U. S.: cotypes, Bishop; Cornell; Field; Gray; Missouri); *George C. Munro 66*, Kaiholena, Lanai, August, 1913 (Bishop); *Munro 131*, outer forest, ridge behind Kaiholena, Lanai, September 28, 1913 (Bishop; Field); *Jules Remy 591*, Lanai, 1851–1855 (Paris); *Joseph F. Rock 8073*, Mahana, Lanai, July, 1910 (Field, 2 sheets; Gray; Vienna); *Rock 8560*, gulches above Makawao, Maui, September, 1910 (Field; Gray; New York); *Dr. Heinrich Wawra 2343*, Hawaiian Isls., 1868–1871 (Vienna); *Wawra 2527*, Maui, same date (Vienna); *Gerrit P. Wilder*, Maui, 1913 (Bishop).

As stated under the foregoing variety *amplectens*, that variety apparently passes into this. Because of the peculiarly obcompressed seeds, I had originally held this to be a valid species. The presence of forms of var. *amplectens*, however, in which most of the seeds are distinctly obcompressed (although still of greater length), seems to cast doubt upon the value here, for purposes of *specific* segregation, of the *obcompressed-seed* character. Anyway, the local and visiting botanists who have collected the two forms have very commonly confused them under the (as seen under var. *lorifolia*, erroneous) designation, *Euphorbia lorifolia*.

7. **Euphorbia olowaluana** Sherff, Bot. Gaz. **97**: 580. 1936.
Chamaesyce olowaluana (Sherff) Croiz. & Deg. *ex* Deg., Fl. Haw. Dec. 9, 1936.

Leaf petiole 1–2 mm. long; blade 1.5–2.5 (rarely –3) cm. long and 4–8 mm. wide; capsule glabrous .... *E. olowaluana*
Leaf petiole 2–3 mm. long; blade up to 6 cm. long and to 1.4 cm. wide; capsule pubescent .... var. *β. gracilis*

Shrub or perhaps a small tree, branched; branches brownish-gray (ultimate ones herbaceous, more often very slender, moniliform, glabrate or very minutely hispidulous, their nodes conspicuous). Leaves opposite and distichous, more often divaricate, the slender petiole weakly puberulous and 1–2 mm. long; blade oblongly linear, at apex obtuse or acute, at base oblique (but only about 1–2 mm. wide), membranous, glabrate,

marked underneath with oblique brownish-purple veins, 1.5–2.5 (rarely –3) cm. long and 4–8 mm. wide; stipular body at first triangular. Capitula commonly solitary in axils and also at tips of branchlets. Involucre subsessile, campanulate or urceolate, outwardly glabrate or near summit tomentulose, about 2.3 mm. tall; glands 4, transversely oblong, subcontiguous. Capsule cernuous, conspicuously trigonal, glabrous, brown, about 2.3 mm. tall; cocci weakly carinate, the keel darker; styles connate at base, shortly bifurcate with much-thickened branches; stipe pubescent, manifest. Seeds ovate, tetragonal, brown (at first rarely grayish), scrobiculate, 1.3–1.5 mm. long.

Type: Collected by *Charles N. Forbes,* no. *2341-M,* central ridge of Olowalu Valley, Maui, May 12, 1920 (Bishop).

Distribution: South-central West Maui.

Specimens examined: *Forbes 2242-M,* Olowalu Valley, Maui, May 7, 1920 (Field); *Forbes 2341-M* (type, Bishop).

Euphorbia olowaluana and its variety *gracilis* appear to constitute a species of somewhat questionable integrity, intermediate between *E. multiformis* (as to often acutish leaves) and its variety *microphylla* (as to herbaceous moniliform ultimate branchlets), on the one hand, and its variety *manoana* and *E. Celastroides* varieties *amplectens* and *mauiensis* (as to appearance of leaves, especially of the brownish-purple venation of their lower surface), on the other.

In view of the existence of so many varieties of *E. multiformis* and *E. Celastroides* as are known to occur, the recognition here of *E. olowaluana* and the variety *gracilis* as apart from them must needs be somewhat arbitrary.

Euphorbia olowaluana var. β. **gracilis** (Rock) Sherff, Bot. Gaz. **97**: 581. 1936.

Euphorbia lorifolia var. *gracilis* Rock, Indig. Trees Haw. Isls., p. 259, *pl. 100.* 1913.

Tree, often 6–9 m. tall; stem often 2.5–3 dm. in diameter, covered with a thinnish pinkish bark, this at first smooth but finally often strewn with conspicuous nodular excrescences; branches very slender and drooping, internodes glabrate or

pubescent, nodes usually puberulent. Leaves larger, petiole 2–3 mm. long; blade linear-oblong, up to 6 cm. long and to 1.4 cm. wide. Involucre outwardly hispidulous especially above; capsule pubescent.

Type: Collected by *Joseph F. Rock*, no. 3593, on lava back of Puuwaawaa, North Kona, Hawaii, June, 1909 (Bishop).

Distribution: Hawaii and West Maui.

Specimens examined: *C. J. Austin*, Puuwaawaa, Hawaii, 1912 (Bishop); *Otto Degener 8087*, arid *aa* lava desert, same locality, August 24, 1926 (Degener); *Charles N. Forbes 6-H*, same locality, June 8–14, 1911 (Bishop); *Forbes 463-H*, slopes of Mauna Kea, Waiki, Hawaii, August, 1911 (Bishop); *Forbes & C. Montague Cooke, Jr., 1-M*, Maunahooma, West Maui, May, 1910 (Bishop); *Albert S. Hitchcock 14270*, Koa forest, Kukaiau Ranch, Hawaii, August 20, 1916 (Bishop; U. S.); *Hitchcock 14809*, tree in upper forest, alt. 3000–5000 ft., Puu Kukui, Maui, September 24–26, 1916 (U. S.); *Alfred Meebold*, alt. 5000 ft., Hualalai, Hawaii, May, 1932 (Bishop); *Meebold*, Hualalai, November, 1935 (Field); *George C. Munro*, Puuwaawaa, Hawaii, June 7, 1923 (Field); *Joseph F. Rock*, same locality, August, 1917 (Bishop); *Rock 3593* (cotypes, Bishop; Gray); *Rock 12968*, Puuwaawaa, August, 1917 (Bishop); *Carl Skottsberg 667*, same locality, September 26, 1922 (Bishop).

In addition to the specimens listed may be mentioned two more: *Forbes 874-H*, Omaokoili, Hawaii, June 17, 1915 (Field); *Rock*, Puuwaawaa, Hawaii, August, 1917 (Bishop). These have smaller leaves, as in the species proper, but the capitula are exceedingly numerous. The involucres are mostly of the yellowish-tomentose, brownish- or yellowish-glanded type found in various forms of *E. Celastroides* and in *E. multiformis* var. *manoana*. The Forbes plant has numerous capsules. These, even though ±3.2 mm. tall, are sterile, giving evidence of hybridity.

8. **Euphorbia atrococca** Heller, Minn. Bot. Studs. **1**: 844, *pl. 50*. 1897.

Chamaesyce atrococca (Heller) Croiz. & Deg. *ex* Deg., Fl. Haw. Dec. 9, 1936.

a. Leaves numerous, 5–13 mm. wide, dull green.
  b. Leaf-blade subcoriaceous, 2–4 cm. long, the lateral veins obscure..*E. atrococca*
  b. Leaf-blade thinner, 3–5.3 cm. long, the lateral veins manifest.........
  ....var. γ. *kilaueana*
a. Leaves fewer, the larger ones 1.2–1.8 cm. wide, darker green....var. β. *kokeeana*

Small tree, about 3 m. tall, with brownish bark, freely branching above; secondary branches numerous, with moderately long (often 1–3 cm.) internodes; glabrous ultimate and subultimate branchlets nodose, slender, suggestive of *E. multiformis,* their internodes mostly 0.5–1.5 cm. long. Leaves numerous but not crowded, opposite, the slender petiole glabrous and 3–4 mm. long; blade narrowly to moderately oblong-oblanceolate, at the obtuse to rounded or subtruncate apex sometimes most minutely retuse, at base more often almost or fully equilateral, at margin entire, dull green, subcoriaceous, 2–4 cm. long and 5–13 mm. wide, midvein prominent especially beneath, lateral veins obscure; stipular body broadly triangular, slightly fringed, ±1 mm. tall. Capitula mostly 3–5 in axillary and terminal clusters (these terminating now glabrous sulcate short peduncles now much abbreviated minutely leaved branchlets). Involucre subsessile, campanulate, outwardly glabrate except on lobes, about 2.2 mm. tall; glands 4, transversely oblong, exappendiculate, well separated; stamens exserted. Capsule (submature) oblong-orbicular in side-view, blackish, about 3 mm. tall, commonly erect; cocci carinate, somewhat concave (but not sulcate) on each side of keel, irregularly appressed-hispid with whitish arcuate hairs; styles connate below, bifurcate nearly half-way, the branches apically thickened; stipe glabrate, ±1 mm. long. Seeds said to be "pitted and rugose."

Type: Collected by *Amos Arthur Heller,* no. *2500,* on the ridge west of the Hanapepe River, Kauai, July 4, 1895 (Minnesota).

Distribution: Known only from type locality in southern Kauai.

Specimens examined: *Heller 2500* (cotypes, Field; Gray; New York); *Heller* (similarly) *2500,* on the Hanapepe and Wahiawa Watershed, southern Kauai, July 4, 1895 (Kew); *Heller* (similarly) *2500,* on the ridge west of the Hanapepe River, Kauai, same date (Paris); *Heller* (similarly) *2500,* same locality, July 11, 1895 (Cornell; Field; Gray); *Heller* (similarly) *2500,* same locality, July 17, 1895 (Field); *Heller* (similarly) *2500,* same locality, August 6, 1895 (Field); *Heller* (similarly) *2500,* same locality, August 22, 1895 (Missouri).

Heller describes the seeds as "pitted and rugose" but an examination of some twenty or more of the numerous apparently

full-sized capsules on his various specimens fails to show even one seed. Uniformly the carpels have only tiny white shriveled abortive ovules (although these indeed are, under a high magnification, more or less "pitted and rugose"). Despite the acceptance, apparently without exception, of this species by various botanists who have collected it (or its var. *kokeeana)* in the field (Heller, Rock, Forbes, and Skottsberg), a genetic study of its status with reference to a possibly hybrid origin is much to be desired. (See remark under var. *kokeeana.)*

Euphorbia atrococca var. β. **kokeeana** Sherff, Bot. Gaz. **97:** 603. 1936.

Leaves fewer, broader (the larger ones mostly 1.2–1.8 cm. wide), darker green, the lateral veins evident.

Type: Collected by *Dr. Carl Skottsberg,* no. *1017,* between Kokee and Mohihi, Kauai, October 29, 1922 (Bishop).

Distribution: Southwestern Kauai.

Specimens examined: *Otto Degener 8094,* Waimea Canyon near Kokee Camp, Kauai, June 30, 1926 (Degener, 2 sheets; Field, 2 sheets; New York); *Charles N. Forbes 435-K,* KahoIuamanu, behind Waimea, Kauai, September, 1909 (Field, 2 sheets); *Amos Arthur Heller 2858,* on KahoIuamanu, above Waimea, September 10–16, 1895 (Bishop); *Heller* (similarly) *2858,* same locality, September 24–30, 1895 (Field); *Heller* (similarly) *2858,* same locality, October 1–8, 1895 (Cornell; Gray; Kew; Missouri; New York; Paris; U. S.); *Joseph F. Rock,* Kaholuamanu, Kauai, October, 1911 (Field); *Rock 10099,* below F. Gray's mountain house, Kaholuamanu, same date (Bishop; Gray); *Rock 12933,* Kaholuamanu, same date (Bishop).

On most specimens the apparently mature capsules are, as in the species proper, devoid of good seeds. On two of the cited *Degener* specimens, however, a few ripe seeds were found. These were ovate-oblong in outline, truncate at base, obtuse at apex, acutely tetragonal with prominently carinate angles, reddish-brown to brownish-black, transversely scrobiculate, 1.8–2 mm. long.

Heller (Minn. Bot. Studs. **1:** 844. 1897) described this as "a well marked form, growing at an elevation of 4000 feet, near the edge of the woods."

Euphorbia atrococca var. γ. **kilaueana** Sherff, Bot. Gaz. **97:** 604. 1936.

Differing from the species proper in its more erect (or at least more antrorsely directed) and more elongate branches, also its thinner leaves (which latter are beautifully spatulate-oblanceolate, apically more often somewhat acute, the blade 3–5.3 cm. long). Inflorescence unknown.

Type: Collected by *Abbé Urbain Faurie*, no. *470*, Kilauea, Kauai, January, 1910 (British).

Distribution: Known only from type locality in northeasternmost Kauai.

Specimens examined: *Faurie 470* (type, British: cotype, Paris; cotype fragment, Bishop).

9. **Euphorbia multiformis** Hooker & Arnott, Bot. Beechey's Voy., p. 95. 1832.

Anisophyllum multiforme Klotzsch & Garcke *ex* Klotzsch, Linn. natürl. Pflanzenkl. Tricocc. Berl. Herb. Allgem. natürl. Ordn. Euphorb., p. 37. 1860.

Chamaesyce multiformis (Hook. & Arn.) Croiz. & Deg. *ex* Deg., Fl. Haw. Dec. 9, 1936.

a. Branchlets pubescent.
  b. Branchlets, involucres, and pedicels densely tomentulose.
    c. Rameal internodes often only 3–6 mm. long; leaf-blades mostly less than 2 cm. long, their veins very obsolete; capitula clustered in groups of 2–5; stamens exceedingly numerous....................var. *θ. kaalana*
    c. Rameal internodes more elongate; leaf-blades mostly 2–3 cm. long, their veins conspicuous underneath; capitula singly disposed; stamens fewer..var. *η. tomentella*
  b. Branchlets spreading-hispidulous.
    c. Leaves mostly under 2 cm. long.
      d. Ultimate branchlets capilliform; leaves very thin; plant of East Maui ....var. *γ. haleakalana*
      d. Ultimate branchlets thicker; leaves moderately thin; plant of Oahu ....var. *ι. perdita*
    c. Leaves mostly over 2 cm. long and moderately thin; plant of Oahu, Lanai, and western Hawaii...........................var. *ε. manoana*
a. Branchlets glabrous or essentially so.
  b. Dwarf shrub up to 6 dm. tall; capitula few, solitary in upper axils; bog plant of southern Kauai..............................var. *ζ. sparsiflora*
  b. Shrub or tree, capitula few or numerous.
    c. Capsular stipe glabrous................................*E. multiformis*
    c. Capsular stipe hispid.
      d. Involucre outwardly glabrous or only slightly pubescent at top.
        e. Ultimate branchlets capilliform or nearly so........var. *δ. kapuleiensis*

e. Ultimate branchlets slender but hardly subcapilliform.......... ....var. β. *microphylla*
d. Involucre outwardly hirtous, densely tomentose at top....var. ε. *manoana*

A glabrous shrub with slender and even extremely nodose (and often very decompound) branches (ultimate ones 1–1.5 mm. thick for most of their length); internodes of a main branch up to 3.2 cm., of branchlets mostly under 2 cm. long. Leaves opposite, the slender petiole glabrous or obsoletely hispidulous and 1–3 mm. long; blade narrow-oblong or -lanceolate or -oblanceolate, at apex subobtuse, obtuse, or rounded to narrowly truncate and rarely subretuse, entire, moderately and more or less gradually narrowed below to a usually equilateral base, at margin not or scarcely revolute, membranous, obscurely veined above, pale and manifestly veined underneath, 2–3.5 cm. long and 0.9–1.4 cm. wide; stipular body very low (±1 mm. tall), rounded. Capitula solitary, terminal and axillary. Involucre campanulate, outwardly glabrous or (especially above) slightly puberulous, 1.5–1.7 mm. tall; glands 4, broader than tall, transversely oblong to oblong-orbiculate, contiguous or nearly so, exappendiculate; lobes ovate or triangular-ovate and at apex somewhat lacerate-hirsute; pedicel only about 1–2 mm. long. Staminophores numerous, conspicuously exserted. Capsule glabrous, cernuous, short-stipitate, about 3 mm. tall and 3 mm. thick; cocci moderately carinate, brown, not sulcate; stipe glabrous; styles very short, connate at base, bifurcate half-way, the branches not thickened. Seeds ovate, tetragonal, grayish, scrobiculate, about 2 mm. long.

Type: Collected by *Lay* and *Collie* (Captain Beechey's Voyage), Oahu, 1826–27 (Kew).

Distribution: Oahu, exact part unknown; perhaps now extinct.

Specimens examined: Lay & Collie, Oahu, 1826–27 (type, Kew).

Euphorbia multiformis was published as a *nomen nudum* (or *subnudum;* a statement was indeed made regarding the variation in size from a small tree at higher altitudes to a herbaceous plant in low cultivated places) by Gaudichaud (Bot. Freycinet's Voy., p. 100. 1830). It was first effectively published

by Hooker and Arnott *(loc. cit.)*. They gave a definite description and cited Gaudichaud only interrogatively. They drew their description from two specimens by Lay and Collie. These specimens, now before me, are mounted on the same sheet and are still well preserved. They are woody-branched and very leafy. They differ at once from all other specimens of this species known to me in having many of the leaves less rounded or obtuse at the apex (although they are still subobtuse or just barely subacute) and in the entirely glabrous capsular stipe. Perhaps this form is no longer extant upon Oahu, but all other forms at present known are *varietally* quite distinct and for a proper understanding of their relationships should be so designated.

The *Gaudichaud* material, as indeed the *Eschscholtz,* the *Maximovicz* (or *Maximowitsch),* and the *Macrae* materials cited by Boissier *(in* DC., Prodr. **15**, pt. 2: 12. 1862) for *E. multiformis,* is referable to variety *manoana.* An additional specimen (Vienna) collected by Lay and Collie on Oahu and distributed from Banks' herbarium as *Phyllanthus distichus,* likewise belongs to the variety *manoana.* Still another specimen collected by Lay and Collie and mounted on the same sheet (Kew) with the type of *E. Hookeri* belongs to the variety *microphylla.* Whether this last specimen had been so mounted prior to Hooker and Arnott's preparation of their description I cannot say, but their respective descriptions of *E. multiformis* and of the plant later named by Steudel *E. Hookeri* clearly do not pertain to it and it thus is to be excluded from our concept of *E. multiformis* proper.

Euphorbia multiformis var. β. **microphylla** Boissier *in* DC., Prodr. **15**, pt. 2: 12. 1862.

Euphorbia multiformis Gaudichaud, Bot. Freycinet's Voy., p. 100. 1830 (in part; *nomen subnudum).*

Euphorbia multiformis var. *tenuior* A. Gray *ex* H. Mann, Proc. Amer. Acad. **7**: 202 (Enum. Haw. Pl., no. 439, var. γ.). 1867.

Euphorbia multiformis var. α. A. Gray *ex* Hillebr., Fl. Haw. Isls., p. 396. 1888.

Mainly glabrous; lateral branches or branchlets slender and usually more elongate (often almost subcapilliform), more or less herbaceous. Leaf petiole often pubescent; blade from elliptic-oblong to cuneately obovate, at apex mostly rounded and more often retuse; very diverse in size, now 2–4.5 cm. now for many branchlets down to 0.5 cm. long. Involucre outwardly glabrous or sometimes slightly pubescent at top; capsule glabrous, its stipe hispid.

Type: Collected by *Jules Remy,* no. *593,* Oahu, 1851–55 (Paris).

Distribution: Oahu and northeastern Molokai.

Specimens examined: *Frederick Debell Bennett 121,* Oahu (Berlin); *Otto Degener & Kwan Kee Park 8040,* rocky moderately wet sunny ridge, Pig God Trail, Punaluu Valley, Oahu, August 11, 1931 (Degener, 2 sheets; Field); *Degener & Kazuto Nitta 8052,* talus, in rainy region not far from ocean, Wailau Valley, Molokai, August 4, 1928 (Degener, 2 sheets; Field; New York); *Degener 8063,* rocky and partly wooded ridge, east rim of Manoa Valley, Oahu, February 28, 1928 (Degener, 2 sheets; Field; New York); *Degener 8072,* rocky region, Hauula Valley, Oahu, September 25, 1927 (Degener; Field; New York); *Degener 8079,* Oahu, February 20, 1927 (Degener; New York); *Degener 8081,* head of Manoa Valley, Oahu, January 9, 1927 (Degener, 2 sheets; Field; New York); *Degener 8082,* moderately wet open region, slope northeast of Nuuanu Valley, Oahu, November 20, 1926 (Degener, 2 sheets; New York); *Degener 8084,* along trail near hairpin turn at Nuuanu Pali, Oahu, November 20, 1926 (Degener); *Degener 8096,* open rocky moderately rainy ridge, northeast of Nuuanu Pali, Oahu, March 28, 1926 (Field; New York); *Degener, K. Park & D. L. Topping 9966,* in rainy forest near summit, Kuliouou Valley, Oahu, June 23, 1935 (Berlin; British; Degener; Delessert; Field; Gray; Kew; Leningrad; Missouri; Paris); *Degener & Park 9967,* edge of forest with *Dicranopteris,* east ridge of Kaipapau Valley, Oahu, July 7, 1935 (Berlin; Degener; Field; Paris); *Abbé Urbain Faurie 469,* Kalihi Pali, Oahu, October, 1909 (Delessert); *Charles N. Forbes,* Upper Kalihi, Oahu, April 2, 1909 (Bishop); *Forbes,* Koolauloa Mountains between Punaluu and Kaipapau, Oahu, November 14–21, 1908 (Field); *Forbes 248-Mo,* Pelekunu Trail, Molokai, July, 1912 (Field, 2 sheets; Missouri); *Forbes 545-Mo,* Wailau Valley, Molokai, September, 1912 (Bishop; Field; Missouri); *Forbes 1048-O,* ridge west of Nuuanu Valley, Oahu, January 20, 1909 (Field); *Forbes 1257-O,* Kalihi Valley, April 2, 1909 (Field, 2 sheets); *Forbes 1427-O,* west side of Nuuanu Valley, Oahu, December 17, 1909 (Field, 2 sheets; Missouri); *Forbes 1668-O,* ridges of Puu-O-Kona, Oahu, March 14, 1911 (Field); *Forbes 2009-O,* ridge east of Kouliouiki, Oahu, November 17, 1914 (Bishop; Missouri); *Charles Gaudichaud,* Hawaiian Isls. (Paris); *Gaudichaud,* Hawaiian Isls., September–October, 1836 (Paris, 2 sheets); *Amos Arthur Heller 2199,* lower slopes of Konahuanui, above Manoa, April 22, 1895 (Missouri; New York; U. S.); *Heller* (similarly) *2199,* at the Pali, Oahu, April 23, 1895 (Cornell; Field, 3 sheets; Gray; Kew; Paris); *Heller* (similarly) *2199,* same place, May 24, 1895 (Bishop; Delessert; Field); *Dr. William Hillebrand,* Oahu (Berlin);

Hillebrand, Nuuanu, Oahu (Kew); *Hillebrand 49*, Oahu (Gray; Kew); *Hillebrand & Rev. John M. Lydgate*, ridge, Hawaiian Isls., May, 1872 (Bishop; the plant may have been collected by Lydgate alone, or else in an earlier year, since Hillebrand himself is said to have left the Hawaiian Islands in 1871—*cf.* W. F. Hillebrand in Hillebr. Fl. Haw. Isls., p. xii, 1888); *Hillebrand & Lydgate, Palolo*, Oahu (Bishop); *Hinds*, Hawaiian Isls. (Kew); *Albert S. Hitchcock 13766*, grassy slope, Nuuanu Pali, Oahu, June 17, 1916 (Bishop; U. S.); *Hitchcock 14058*, same place, July 19, 1916 (U. S.); *Lay & Collie* (Capt. Beechey's Voy.), Oahu (Kew, where mixed with *Euphorbia Hookeri*); *H. L. Lyon 12934*, Niu Ridge, Oahu, August 29, 1909 (Bishop); *James Macrae*, Oahu, May, 1825 (Kew); *Horace Mann & William T. Brigham 101 pro parte*, Oahu, 1864–1865 (Field; Gray; Missouri; New York); *Mann & Brigham 244*, Hawaiian Isls., 1864–1865 (Bishop; Cornell); *Alfred Meebold*, alt. 2500 ft., Punaluu, Oahu, May, 1932 (Bishop); *Dr. Meyen*, Oahu (Missouri); *Thomas Nuttall*, Oahu, 1835 (Kew); *R. Onauye*, small tree about 12 ft. tall, rain forest, alt. 1700 ft., Maakua-Papali ridge, Kaipapau Forest Reserve, Hauula, Koolau Mountains, Oahu, October 15, 1933 (New York); *Remy 593* (type, Paris); *Joseph F. Rock 3038*, Niu Valley, Oahu, December, 1910 (Gray; New York); *Rock 4822*, alt. 1200 ft., same locality, August 22, 1909 (Bishop; Gray; Vienna); *Rock 17068*, Palolo-Manoa Valley, Oahu, May, 1918 (Bishop); *Rock 17327*, dry section of Waiahole, Oahu, December, 1919 (Bishop); *Rock 17328*, wet forest, along trail at Waiahole, Oahu, December, 1919 (Bishop); *Rock & O. Swezey*, Niu Valley, Oahu, December, 1910 (Field); *Harold St. John 10090*, bush 5 ft. tall, open woods, alt. 2100 ft., Kaluanui, Oahu, November 30, 1929 (Field); *Dr. Berthold Seemann 1728*, Oahu, May, 1849 (Gray; Kew); *John F. G. Stokes*, Kanapou Bay, Kahoolawe (Bishop); *United States Exploring Expedition*, Oahu, 1840 (U. S); *U. S. Explor. Exped.*, barren hills behind Honolulu, Oahu, 1840 (Gray); *Dr. Heinrich Wawra* 1754, Oahu, 1868–71 (Vienna, 2 sheets); *Wawra 2341*, Hawaiian Isls., 1868–71 (Vienna).

At times the plants are more sarmentose, the numerous additional delicate branchlets having an abundance of smaller leaves and bearing capsules down to 1.6 mm. long with seeds about 1.4 mm. long.

Euphorbia multiformis var. γ. **haleakalana** Sherff, Bot. Gaz. **97**: 591. 1936.

In habit very similar to variety *microphylla*. Branches and leaf petioles hispid. Involucre outwardly now glabrate now (especially toward summit) spreading-hispid; glands more often spreading; pedicel densely and spreadingly white-hispid. Capsule about 1.5 mm. tall, its stipe spreading-hispid.

Type: Collected by *Charles N. Forbes*, no. *2010-M*, Auwahi, southernmost East Maui, March 18, 1920 (Field).

Distribution: Known only from type locality in East Maui.

Specimens examined: *Forbes 2010-M* (type, Field).

Euphorbia multiformis var. δ. **kapuleiensis** Degener & Sherff *ex* Sherff, Bot. Gaz. **97**: 591. 1936.

Similar to variety *microphylla*. Shrub about 1.8 m. tall, very delicate, branches elongate and almost pendulous; ultimate branchlets subcapilliform or capilliform; internodes commonly more elongate; leaves commonly linear-oblong or narrowly elliptic, petiole 2–3.5 mm. long, blade less than 3 cm. long.

Type: Collected by *Otto Degener*, no. *8053*, 6 ft. tall, with long almost drooping branches, rare, up ridge called Kapulei to east of white mountain Kaholoapele and back in east gully, growing on arid cliff near mango trees in east gully, Molokai, June 25, 1928 (Delessert).

Distribution: Southeastern Molokai.

Specimens examined: *Degener 8053* (type, Delessert: cotypes, Degener; Field; New York); *Degener 8056*, on arid cliffs, second eastern gulch, Wawaia, Molokai, June 27, 1928 (Degener, 3 sheets; Field); *Degener 8061*, one of the dry valleys between Kamalo and Kaunakakai, Molokai, July 29, 1928 (Degener, 2 sheets; Delessert; Field, 2 sheets).

Euphorbia multiformis var. ε. **manoana** Sherff, Bot. Gaz. **97**: 591. 1936.

Euphorbia multiformis Gaudichaud, Bot. Freycinet's Voy., p. 100. 1830 (in part; *nomen subnudum)*; Boiss. *in* DC., Prodr. **15**, pt. 2: 11. 1862 (from the description and synonym of Gaudichaud [in part] and from the plants of Eschscholtz, of Maximovicz, and of Macrae; excluding syn. Hook. & Arn.).

Younger branches glabrous (as on type) or spreading-hispidulous. Leaves more often elliptic-oblong to cuneately oblanceolate, at apex mostly rounded or truncate-rounded and often retuse, sometimes hispidulous underneath and often with tomentulose petiole. Involucre outwardly papillate-hirtous below and densely tomentose at top.

Type: Collected by *Carl Johann Maximovicz (Maximowitsch)*, no. *145*, Honolulu, Oahu (Kew).

Distribution: Oahu, Lanai, and western Hawaii.

Specimens examined: *Mr. Ballieu*, Hawaiian Isls. (Paris); *Otto Degener H-213*, on Tantalus side of Manoa Valley, Oahu, February 12, 1923 (Degener, 2 sheets; Field; New York, 2 sheets); *Frederick Eschscholtz*, Oahu, 1816–17 (Delessert;

Gray; Kew); *Charles N. Forbes,* ridge west of Kalihi Valley, Oahu, August 18, 1908 (Field, 2 sheets; Missouri); *Forbes 358-H,* growing 12 ft. tall, with drooping branches, Kanehaha, Kona, Hawaii, July 25, 1911 (Bishop); *Forbes 1660-O,* Pacific Heights ridges, Oahu, March, 1911 (Field, 2 sheets); *Forbes 1838-O* and *1842-O,* Waianae Mountains, Kawaihapai, Oahu, February 14, 1913 (Field; apparently a second growth form, the larger leaves with blades up to 7.6 cm. long and 2.7 cm. wide); *Charles Gaudichaud,* Hawaiian Isls., 1819 (Berlin); *Dr. William Hillebrand,* Honolulu, Oahu (Vienna); *Lay & Collie* (Capt. Beechey's Voy.), Oahu, 1826–27 (Vienna); *James Macrae,* Oahu, May 20, 1825 (Berlin; New York; Vienna); *Maximowicz 145* (type, Kew: cotype, Berlin); *George C. Munro 69,* Maluea, Lanai, December 27, 1913 (Bishop); *Munro 80,* same locality and date (Bishop, 2 sheets); *Joseph F. Rock,* right-hand branch of Wailupe Valley, Oahu, April 14, 1918 (Bishop); *Rock 8126,* Koele, Lanai, August 3, 1910 (Field); *Carl Skottsberg 1073,* Nuuanu-Pauoa ridge, Oahu, November 5, 1922 (Bishop); *United States Exploring Expedition,* Oahu, 1840 (Missouri; U. S.); *Adelbert Von Chamisso 182,* Oahu, 1816–17 (Berlin; Leningrad).

Boissier, to whom this variety represented the species proper, described the plants as glabrous. In two of the collections cited by him (Eschscholtz's and Macrae's), however, the younger branchlets and leaf petioles and lower surfaces are more or less hispidulous; so also for some of Gaudichaud's original material, namely, Kunth's ample fragment (Berlin). The difference in pubescence seems hardly constant enough to justify attempts at further delimitation.

Perhaps hybridizes with *E. Celastroides (qu. vide)* or one of its varieties.

Euphorbia multiformis var. ζ. **sparsiflora** (Heller) Sherff, Bot. Gaz. **97**: 590. 1936.

Euphorbia sparsiflora Heller, Minn. Bot. Studs. **1**: 846, *pl. 51.* 1897.

Euphorbia palustris Heller, *loc. cit.* 847.

A glabrous shrub, 2.5–6 dm. tall, stems slender, branched, the branches ascending. Leaves oblong-oblanceolate to obovate, evenly narrowed to a cuneate base, rounded and blunt at the apex, blade 1.5–2.8 cm. long. Capitula few, solitary in the upper axils.

Type: Collected by *Amos Arthur Heller,* no. *2699,* at altitude of 3000 feet, in bog at head of the Wahiawa River, Kauai, 1895 (Minnesota).

Distribution: Southern Kauai.

Specimens examined: *Abbé Urbain Faurie 467,* Hanapepe, Kauai, December, 1909 (British; Paris); *Charles N. Forbes 206-K,* Wahiawa Swamp, Kauai, August, 1909 (Field, 2 sheets); *Heller 2699,* in and near a bog at the head of the Wahiawa River, Kauai, August 12, 1895 (Bishop, 2 sheets; Field, 2 sheets; Gray; Missouri; New York); *Heller* (similarly) *2699,* same locality, August 21, 1895 (Paris); *Heller* (similarly) *2699,* same locality, October 19, 1895 (Cornell; Field, 2 sheets); *Rev. J. M. Lydgate,* Wahiawa Mountains, Kauai (Bishop).

In herbarium specimens the stems are apt to be covered with moss and other swamp vegetation. Faurie gives merely "Hanapepe" for his locality, but the conspicuous investment of bog moss around the lower stem of one of his specimens betrays a bog habitat.

Euphorbia multiformis var. η. **tomentella Boissier** *in* DC., Prodr. **15,** pt. 2: 12. 1862. (Pl. 9.)

The numerous branchlets tomentulose to tomentose. Leaves resembling those of var. *manoana,* petiole 2–3 mm. long and densely tomentose; blade with conspicuous veins on lower surface (which is more or less tomentulose, especially toward petiole), up to 3.2 cm. long. Capitula singly disposed at the nodes, conspicuously tomentose, about 3 mm. across, the glabrate to sparsely pilose glands brownish-black; staminophores not numerous. Capsules not known.

Type: Collected by *Jules Remy,* no. *594,* Oahu, 1851–1855 (Paris).

Distribution: Oahu.

Specimens examined: *Remy 594* (type, Paris).

Euphorbia multiformis var. θ. **kaalana** Sherff, Bot. Gaz. **97:** 590. 1936.

Branchlets slender but conspicuously nodose, tomentulose, the numerous internodes often only 3–6 mm. long. Leaf petioles tomentulose, about 1–1.5 mm. long; blade more or less obovate, membranaceous, basally oblique, apically rotundate and often even retuse, silvery-tomentulose underneath, less than 2 cm. long, the veins very obsolete. Capitula rather numerous, often clustered in groups of 2–5 at the tips of very minute axillary branchlets, conspicuously tomentose, about 3 mm. wide; glands brown, more or less glabrate; anthers ex-

ceedingly numerous. Capsules minutely pilose, about 2.5 mm. tall and about 3 mm. wide. Seeds subtetragonal, scrobiculate, 1.5 mm. long.

Type: Collected by the *United States Exploring Expedition,* Waianae, western Oahu, 1840 (U. S.).

Distribution: Known only from type locality in western Oahu.

Specimens examined: *U. S. Explor. Exped.,* Waianae, Oahu, 1840 (type, U. S.: cotype fragments, Bishop; Gray; Missouri).

A transitional form which might almost as well be considered a variety of *E. Celastroides* Boissier. It was confused by Asa Gray with *E. multiformis* var. *tomentella* Boiss., a plant with leaf blades mostly 2–3 cm. long, their veins conspicuous underneath, internodes of branchlets more elongate, capitula singly disposed, stamens fewer, etc.

Euphorbia multiformis var. ι. **perdita.**

Varietas nova. Ramuli tenues suberecti, moderate nodosi internodiis saepius 8–15 mm. longis, aegre brevissimeque patenti-hispidi, saepius circ. 1 mm. crassi. Folia principalia anguste oblonga, apice truncata vel emarginata basi inaequilateralia (lamina ±1.8 cm. longa et 6.5 mm. lata, petiolo ±2 mm. longo); ramulorum parva et sub 1 cm. longa, oblongo-obovata, apice truncata vel emarginata, basi truncata vel parce subcordata, membranacea, petiolo tenui ±1 mm. longo marginibusque pubescentia aliter glabrata, venis obsoletis. Capitula numerosa, plerumque in ramulis minutis axillaribus 2–5-adgregata, albido-tomentulosa, circ. 3 mm. crassa, glandulis siccis brunneis glabratis; antheris numerosis; capsula plus minusve albo-pubescenti, subsessili; seminibus subtetragonis, scrobiculatis, circ. 1.4 mm. longis.

Branchlets slender, suberect, moderately nodose (internodes more often 8–15 mm. long), weakly and very shortly spreading-hispid, more often about 1 mm. thick. Principal leaves narrowly oblong, apically truncate or emarginate and basally oblique (blade ±1.8 cm. long and 6.5 mm. wide, petiole ±2 mm. long); leaves of the branchlets small and under 1 cm.

long, oblong-obovate, apically truncate or emarginate, basally truncate or scarcely subcordate, membranaceous, petiole (slender and ±1 mm. long) and margins pubescent but surfaces glabrate, veins obsolete. Capitula numerous, commonly 2–5-clustered on minute axillary branchlets, whitish-tomentulose, about 3 mm. thick, the glabrate glands brown when dry; anthers numerous; capsule more or less white-pubescent, subsessile; seeds subtetragonal, scrobiculate, about 1.4 mm. long.

Type: Collected by *Adelbert Von Chamisso,* island of Oahu, 1816–1817 (Field).

Distribution: Oahu.

Specimens examined: *Von Chamisso,* Oahu, 1816–1817 (Field, type).

10. **Euphorbia Skottsbergii** Sherff, Bot. Gaz. **97**: 588. 1936. *Chamaesyce Skottsbergii* (Sherff) Croiz. & Deg. *ex* Deg., Fl. Haw. Dec. 9, 1936.

a. Principal leaves entire or seldom very obscurely denticulate near apex; plants of southwestern Oahu.
 b. Prostrate, ultimate branchlets slender but not capilliform.... *E. Skottsbergii*
 b. Erect, ultimate branchlets capilliform.................. var. *β. kalaeloana*
a. Principal leaves often denticulate; plants of northwesternmost Molokai.
 b. Leaves commonly elliptic or narrowly obovate-elliptic.... var. *δ. Vaccinioides*
 b. Leaves elliptic-oblong to suborbicular........................ var. *γ. audens*

Prostrate shrub, ramose; branches slender (ultimate ones exceedingly so), nodose, divaricate, the youngest ones tomentulose. Leaf petioles slender, tomentulose, 1–3 mm. long; blade variously obovate-oblong, oblong-elliptic, or obovate-subrhombic, basally often obliquely cuneate-rotundate, apically obtuse or rotundate, at the scarcely subrevolute margin flat or subrepand (toward apex very rarely obsolete-denticulate), membranaceous, glabrate above, more or less hispidulous below, commonly 1–2 cm. long and 7–13 mm. wide; interpetiolar body scarcely 0.5 mm. tall. Capitula commonly disposed along very minute axillary branchlets. Involucre not truly pedicellate, minute, campanulate, glabrate or moderately hispidulous, only about 1–1.1 mm. tall; glands 4 or more rarely 5, transversely oblong, exappendiculate, remote or almost contiguous; lobes minute, erectly oblong, fimbriate; staminophores ex-

serted. Capsule minute, glabrate, only about 1.6 mm. tall, cernuous, stipitate, short-hispidulous; cocci scarcely carinate, not sulcate; styles distinct, bifurcate almost to the middle. Seeds ovate, tetragonal, basally truncate, apically obtuse, cinereous, papillate-scrobiculate, about 1.1 mm. long.

Type: Collected by *Dr. Carl Skottsberg,* no. *122,* Ewa coral flat, Oahu, August 11, 1922 (Bishop).

Distribution: Near southern coast of Oahu, from Barbers Point eastward toward Pearl Harbor.

Specimens examined: *Otto Degener 8050,* arid fossil reef, between Barbers Point and Pearl Harbor, Oahu, May 8, 1932 (Degener; Field; New York); *Charles N. Forbes 2330-O,* coral plain below Ewa and Sisal, Oahu, March 14, 1916 (Field, 4 sheets); *Skottsberg 122* (type, Bishop); *Otto H. Swezey,* Oahu (Bishop).

To be distinguished from the somewhat similar *E. multiformis* var. *kaalana,* with which it has been confused in herbaria, by its smaller and less tomentulose involucres, its much smaller capsules, etc.

Euphorbia Skottsbergii var. β. **kalaeloana** Sherff, Bot. Gaz. **97**: 589. 1936. (Pl. 10.)

Erect, more branched; ultimate branchlets more often capilliform. Leaves smaller, more often 5–9 (rarely –14) mm. long.

Type: Collected by *Joseph F. Rock,* no. *17034,* coral plain, under algaroba, back of Barbers Point, Oahu, November, 1919 (1st sheet, Gray; 2nd sheet, Bishop).

Distribution: Known only from type vicinity of Barbers Point (Kalaeloa), southern coast of Oahu.

Specimens examined: *Charles N. Forbes* (with C. Montague Cooke, Jr.) *1760-O,* near Sisal, Oahu, February 12, 1912 (Field); *Rock 17034* (1st type sheet, Gray; 2nd type sheet, Bishop).

Euphorbia Skottsbergii var. γ. **audens** Sherff, Bot. Gaz. **97**: 589. 1936.

Leaf-blade rotundate or more often oblong or elliptic-oblong, at the often emarginate apex obtuse or subtruncate, at the often oblique base narrowed or truncate or more rarely somewhat subcordate, on each edge cartilaginous and commonly (but not always) 3–10-denticulate with the sharp and indurated teeth

subspreading-antrorse; stipular body triangular (very widely so), finally often cleft, scarcely 1 mm. tall. Involucral glands commonly 5 more rarely 4, yellow (or when dry blackish-brown), commonly contiguous. Capsule sparsely pilose at base; seeds about 1.3 mm. long.

Type: Collected by *Charles N. Forbes,* no. *620-Mo,* beach near Ka Lae Ka Ilio Ilio, Molokai, March 25, 1915 (Missouri).

Distribution: Near coast, northwesternmost Molokai.

Specimens examined: *Otto Degener 8066,* on arid coastal chiefly basic rocks, near Pohahumauliuli, Molokai, April 28, 1928 (Degener, 2 sheets; New York); *Degener 8068,* arid region near the coast, near Waiakanapo, Molokai, April 19, 1928 (Degener, 2 sheets; Field; New York); *Degener 8071,* on aeolian lime deposits in arid region, near Moomomi, Molokai, April 25, 1928 (Degener, 2 sheets; Field; New York); *Forbes 620-Mo* (type, Missouri).

Euphorbia Skottsbergii var. δ. **Vaccinioides** Sherff, Bot. Gaz. **97**: 589. 1936.

Leaves commonly elliptic or narrowly obovate-elliptic, on each edge often 1–12-denticulate.

Type: Collected by *Joseph F. Rock,* no. *14072,* west end flats, Molokai, April, 1918 (Bishop).

Distribution: Western Molokai.

Specimens examined: *Otto Degener 8065,* on small limestone *kipuka* in sand dunes southeast of Moomomi, Molokai, April 29, 1928 (Degener); *Joseph F. Rock 14029, Hawaiian Isls.* (Bishop); *Rock 14072* (type, Bishop).

11. **Euphorbia Hillebrandii** Léveillé *in* Fedde, Repert. **10**: 151. 1911.

Chamaesyce Hillebrandii (Lévl.) Croiz. & Deg. *ex* Deg., Fl. Haw. Dec. 9, 1936.

a. Capitula usually solitary or subsolitary.
  b. Larger leaves commonly 4–6 cm. long and 1.5–2 (or even to 3.3) cm. wide .... *E. Hillebrandii*
  b. Larger leaves commonly under 4 cm. long and under 1.5 cm. wide........ var. γ. *waimanoana*
a. Capitula in a much contracted 3–10-cephalous inflorescence..... var. β. *palikeana*

Shrub probably 1–2 m. tall, glabrous, stems moderately nodose, branches slender and somewhat herbaceous. Leaves opposite and distichous, the slender and more or less hispidulous petiole 1–4 mm. long; blade narrowly or sometimes

broadly oblong-elliptic, narrowed to rounded or rarely somewhat subcordate at the often oblique base, more or less gradually narrowed above middle to a subacute or acute (or more rarely subacuminate) apex, very entire, slightly revolute, 2–6 cm. long and 1.2–2 (rarely –3.3) cm. wide; stipular body a mere ridge 1–1.5 mm. tall. Inflorescence much as in *E. Hookeri* var. *integrifolia,* the capitula usually solitary (very rarely 3–5). Capsule trigonous, glabrous, about 2.2 mm. tall but nearly 3 mm. thick; cocci moderately carinate, not sulcate; stipe now glabrous or glabrate now pubescent; styles connate at base, bifurcate half-way into apically somewhat thickened branches. Seeds much as in *E. Hookeri,* about 1.1 mm. long.

Type: Collected by *Abbé Urbain Faurie,* no. *468,* Kaala, Oahu, December, 1909 (herbarium not cited but perhaps Paris).

Distribution: Northern and central Oahu; northwesternmost Maui.

Specimens examined: *Anon. 160,* shrub about 4 ft. tall, alt. 2500–3000 ft., east side trail, Puu Kaala, Oahu, July 22, 1928 (Field); *H. F. Bergman,* alt. 1700 ft., moist woods, east side of ridge on trail to Puu Kaala, Oahu, February 11, 1928 (Bishop; Field); *J. C. Bridwell,* Puu Kaala, Oahu, January, 1920 (Bishop); *Edwin H. Bryan, Jr., Amy Suehiro & M. Fukuda,* alt. 1200–1400 ft., zone 2, south ridge of Kipapa Gulch, Waipio, Koolau Mountains, Oahu, May 15, 1932 (Bishop); *Otto Degener 8048,* moderately dry open woods, below Palikea on Honolulu side, Oahu, October 23, 1932 (Degener; Field; New York); *Degener 8080,* dry shaded ridge, near Mauna Kapu, Waianae Mts., Oahu, January 15, 1927 (Degener, 2 sheets; Field; New York); *Degener & Kwan Kee Park 8044,* becoming 5 ft. tall, open forest, Kanehoa, Oahu, July 5, 1931 (Degener; Field; New York); *Degener, Park & Y. Nitta 8046,* in woods, Pupukea-Kahuku region, Oahu, May 28, 1932 (Degener; Field; New York); *Degener, Park & Nitta 8047,* same locality and date (Degener; New York); *Degener, Park, Potter, Bush & Topping 9963,* at edge of forest, Waimano, Oahu, June 9, 1935 (Berlin; Degener; Delessert; Field; Gray; Kew; Missouri; New York; Paris; Vienna); *Degener, Park, Potter, Bush & Topping 9975,* open rainy woods, Malaekahana Trail, Laie, Oahu, July 29, 1935 (Degener; Field; Kew; Paris; Vienna); *Degener, Park, Shigeura & Takamoto 10114,* sunny exposed ridge, between Palehua and Palikea, Oahu, December 16, 1935 (Berlin; British; Cornell; Degener; Delessert; Field; Gray; Kew; Missouri; New York; Paris; Philadelphia; U. S.; Vienna); *Degener & C. L. Shear 8059,* on *Dicranopteris*-covered partly wooded ridge, Waipio-Waiawa Ridge, Oahu, March 5, 1928 (Degener; Field, 2 sheets; New York); *Faurie 468* (cotypes, British; Paris); *Charles N. Forbes,* Koolauloa Mountains between Punaluu and Kaipapau, Oahu, December 14–21, 1908 (Bishop); *Forbes,* Makaha Valley, "Kaala Moun-

tains" (Waianae Mountains), Oahu, February 12–19, 1909 (Bishop); *Forbes 352-M,* Honokohau Drainage Basin, Maui, September 25–October 17, 1917 (Bishop); *Forbes 1159-O,* "Kaala Mountains" (Waianae Mountains), February 12–19, 1909 (Field; Missouri); *Forbes 1679-O,* Palehua, Waianae Mountains, Oahu, April 1–4, 1911 (Field, 2 sheets; Missouri); *Forbes 1770-O pro parte,* Mokuleia, slopes of Puu Kaala, Oahu, April 26–May 16, 1912 (Field); *Forbes 2042-O,* ridge north of Waimea Valley, Oahu, February 10–13, 1915 (Bishop); *Forbes 2104-O,* Kawailoa, Oahu, March 2–5, 1915 (Bishop; Missouri); *Dr. William Hillebrand,* Waiawa, Oahu (Bishop); *E. P. Hume 81,* alt. 400 m., valley bottom, Kipapa, Oahu, February 15, 1931 (Bishop); *R. Lyman,* damp forest, south ridge, Kipapa Gulch, Koolau Mountains, Oahu, November 10, 1929 (Bishop); *A. Meebold,* alt. 1500 ft., Pupukea, Oahu, May, 1932 (Bishop); *Joseph F. Rock 17030,* Mokuleia-Makaleha, Oahu, April, 1918 (Bishop); *Carl Skottsberg 220,* ditch trail, Oahu, August 15, 1922 (Bishop); *Skottsberg 269,* Palehua, Waianae, Oahu, August 23, 1922 (Bishop); *Skottsberg 366-b,* north slope of Puu Kaala, Waianae, Oahu, August 30, 1922 (Gothenburg).

Apparently hybridizes with varieties of *E. Celastroides (qu. vide).*

Euphorbia Hillebrandii var. β. **palikeana** Degener & Sherff *ex* Sherff, Bot. Gaz. **97**: 581. 1936.

Inflorescence 3–10-cephalous, much contracted, 0.5–1.5 cm. long, the bracteolate nodules numerous and conspicuous.

Type: Collected by *Otto Degener, Kwan Kee Park, and William Bush,* no. *8049,* open woods, in third small valley northeast of Palikea, Oahu, September 19, 1932 (N. Y.).

Distribution: Known only from type locality in southwestern Oahu.

Specimens examined: *Degener, Park & Bush 8049* (type, New York: cotype, Degener); *McDaniels (Dr. Carl Skottsberg* distrib. no.) *2091,* Wahiawa-Waipio ridge, Koolau, Oahu, October 6, 1922 (Gothenburg).

Perhaps a mere state of the species proper.

Euphorbia Hillebrandii var. γ. **waimanoana** Sherff, Bot. Gaz. **97**: 581. 1936.

Chamaesyce Hillebrandii var. *waimanoana* (Sherff) Croiz. & Deg. *ex* Deg., Fl. Haw. Dec. 9, 1936.

Branches ascending, virgate, sulculate, glabrous, moderately nodose, internodes more often 1.3–3 cm. long. Leaf petioles slender, spreading-hispidulous, 1–2 mm. long; blades elliptic-lanceolate or (often subrhomboidally) oblanceolate-oblong, at

apex subacute or acute and almost mucronate, at base oblique and narrowed or subtruncate, glabrous, membranaceous, at margin scarcely subrevolute, somewhat paler underneath, 2–4 cm. long and 7–15 mm. wide; interpetiolar bodies widely triangular, ±0.5 mm. tall. Capitula axillary and terminal (sometimes upon minute subcapilliform axillary branchlets), solitary or subsolitary. Involucre campanulate, minute (under 1.5 mm. tall), outwardly glabrate; lobes hirtous; glands 5, transversely oblong, more or less contiguous, exappendiculate; stamens exserted; pedicel glabrous, less than 1 mm. long. Capsule (submature) glabrous, scarcely 2 mm. tall, cocci moderately carinate and esulculate; stipe glabrous, ±4 mm. long; styles distinct, bifurcate almost to the middle; seeds not seen.

Type: Collected by *Charles N. Forbes* (with *Dean Lake*), no. *1978-O*, Waimano Ridge, Oahu, October 27–30, 1914 (Bishop).

Specimens examined: *Forbes 1978-O* (type, Bishop).

Perhaps to be regarded as specifically distinct, therefore described rather fully here. The varietal name was unfortunately misspelled in the original description, to read *wainianana*.

12. **Euphorbia Hookeri** Steudel, Nomencl. ed. 2, **1**: 612. 1840; Boissier, Icon. Euphorb., *tab. 3.* 1866.

Euphorbia myrtifolia Hook. & Arn., Bot. Beechey's Voy., p. 95. 1832 (not L.).

Anisophyllum virgatum Klotzsch & Garcke *in* Klotzsch, Linn. natürl. Pflanzenkl. Tricoccae Berl. Herb. Allgem. natürl. Ordn. Euphorb., p. 36. 1860.

Euphorbia coriariaefolia Boiss. *in* DC., Prodr. **15**, pt. 2: 12. 1862.

Euphorbia Arnottiana Endlich., Fl. Suds. no. 1564, *fide* Drake del Castillo, Illustr. Fl. Ins. Mar. Pacif., p. 285. 1892.

Chamaesyce Hookeri J. C. Arthur, Torreya **22**: 30. 1922.

Leaves more or less repand-denticulate; styles distinct to base........*E. Hookeri*
Leaves hardly repand, entire; styles connate at base...........var. *β. integrifolia*

Shrub 0.9 rarely up to 1.8 m. tall, glabrous, pale throughout, cauline nodes conspicuous; branches slender, subherbaceous, flexuous, weakly nodose, internodes more often 2–4 cm. long. Leaves opposite and distichous, petiole obsoletely hispidulous and about 2–4 mm. long; blade ovate or rarely subrotund, at apex acute or more rarely subobtuse, at base cuneate rotundate or subcordate often oblique, at margin more or less repand-denticulate, membranaceous, appearing polished beneath, 2–5 cm. long and 1.5–3 cm. wide, lateral veins inconspicuous; stipular body a low margin-like ridge. Capitula axillary and terminal, single on pedicels about 1–2 mm. long or several in simple or compound cymes (these commonly 1 to a node and arising alternately on each side of stem, often 2–5 cm. long); cyme branches multibracteate with pairs of minute rounded scarious bractlets but bearing only 1–3 capitula at their ends. Involucre minute, turbinate, outwardly glabrous, bearded at the throat, 1–2 mm. tall; glands 4 or even 5, transversely ovate; lobes triangular-ovate, truncate; staminophores more often not exserted. Capsule exserted, cernuous, finally glabrous, 2.2–2.8 mm. tall, cocci slightly carinate; styles distinct to base, their short branches thickened. Seeds ovate- tetragonal, grayish to brownish-red, 1.2–1.5 mm. long, scrobiculate with reticulate ridges and variously shaped but somewhat more often transverse pits.

Type: Collected by *Lay and Collie* (on Captain Beechey's Voyage), Oahu, 1826–27 (Kew).

Distribution: Southeastern Oahu.

Specimens examined: *Otto Degener 8101*, common on open wooded slope, middle ridge of Niu Valley, Oahu, June 4, 1932 (Degener, 4 sheets; Field; New York); *Charles N. Forbes 1578-O*, Wailupe Valley, Oahu, April 12, 1910 (Field; Missouri); *Forbes* (with *J. C. Bridwell) 2463-O*, same locality, April 11, 1917 (Bishop); *Forbes 2503-O*, same locality, May 4, 1917 (Field); *Forbes 2528-O*, Wailupe, Oahu, January, 1919 (Bishop; Field); *Charles Gaudichaud*, Hawaiian Isls., October, 1836 (Berlin, labeled *Anisophyllum virgatum* by Klotzsch & Garcke and evidently their type); *Gaudichaud 287*, same locality, September–October, 1836 (Paris); *Dr. William Hillebrand*, Nuuanu, Oahu (Kew); *Hillebrand*, Niu, Oahu, 1867 (Berlin); *Hillebrand 50*, low shrub, Oahu (Kew); *Hinds*, Oahu (Kew); *Lay & Collie* (Capt. Beechey's Voyage), Oahu, 1826–27 (type, Kew); *Horace Mann*, Hawaiian Isls. (Berlin); *Mann & William T. Brigham*, Hawaiian Isls., 1864–1865 (Cornell); *Mann & Brigham 103*, ridge east of Manoa, Oahu, October, 1865 (Bishop; Cornell; Gray;

Missouri); *Adelbert von Chamisso*, Oahu, 1816–17 (Berlin, where labeled *Anisophyllum virgatum* by Klotzsch & Garcke; Leningrad, 3 sheets).

Euphorbia Hookeri var. β. **integrifolia** Hillebrand, Fl. Haw. Isls., p. 397. 1888.

Leaves hardly repand, entire. Capitula singly disposed or few in short cymes (1–3.5 cm. long). Styles connate at base.

Type: Collected by *Dr. William Hillebrand*, western Maui (Berlin).

Distribution: Western Maui (Hillebrand cites also Lanai).

Specimens examined: *Otto Degener 8073*, dry mountain near Waihee, west Maui, July 2, 1927 (Degener, 2 sheets; New York); *Hillebrand*, west Maui (type, Berlin); *Hillebrand*, same locality (Kew); *Hillebrand*, Kanapali, west Maui (Gray).

13. **Euphorbia festiva** Sherff, Bot. Gaz. **97**: 589. 1936.

Chamaesyce festiva (Sherff) Croiz. & Deg. *ex* Deg., Fl. Haw. Dec. 9, 1936.

Shrub; branches glabrous, sulcate, nodose, the internodes 1–1.4 cm. long and 1–2 mm. thick; branchlets suberect, angulate, sulculate, sparsely hispidulous above, their internodes commonly 0.5–1 cm. long and 0.5–1 mm. thick, nodes twice as thick as internodes. Leaves opposite and distichous, the slender petiole glabrate and only about 1 mm. long; blade oblong or more rarely ovate-oblong, at apex often very minutely emarginate and obtuse or subrotund, at the oblique base nicely and broadly subcordate or even moderately cordate, on each margin very narrowly indurated and not truly revolute but commonly very obsoletely 1–8-denticulate, membranous, on both surfaces glabrous, paler underneath, 7–16 mm. long and 5–11 mm. wide; stipular body triangular, pubescent, under 1 mm. tall. Capitula terminal (at least so far as observed on 8 flowering branchlets found), solitary; involucre subsessile, campanulate, outwardly glabrate or supernally hispidulous, about 1.8–2.1 mm. tall; glands commonly 5, transversely oblong, not or obsoletely appendiculate, more or less contiguous; lobes hirtous; stamens exserted. Capsule (mature) not known; styles connate at base, strongly bifurcate, branches thickened.—Description drawn from the single type branch, which is less than 1.7 dm. long.

Type: Collected by *Thomas Nuttall,* Oahu, 1835 (Kew).
Distribution: Present, at least a century ago, on Oahu.

Specimens examined: *Nuttall,* Oahu, 1835 (type, Kew).

Nuttall had designated the type as a new species, but later Edmond Boissier determined it as *Euphorbia multiformis* H. & A. The oblong basally wide-cordate or -subcordate leaves, with their obsolete yet definitely visible teeth, easily distinguish Nuttall's plant, however, from that species. In the vast assortment of specimens of Hawaiian *Euphorbiae* studied by me from the principal European and American herbaria, no others have been found to belong here, and it may well be that during the century since Nuttall collected on Oahu the species has become extinct. (An inaccuracy in my original description [*loc. cit.*] of the branchlets, making the length of their internodes apply erroneously to the branchlets themselves, has been corrected above.)

14. Euphorbia Degeneri Sherff, Bot. Gaz. **97**: 583. 1936.
Euphorbia cordata Meyen, Beiträge Bot. Reise Erde **2**: 150. 1843 (not Schrank, Baier. Fl. **1**: 747. 1789; nor Räuschel, Nomencl. Bot. edit. III, p. 140. 1797); Boiss. Icon. Euphorb., *tab. 4.* 1866 (where leaves are erroneously shown as decussate instead of distichous).
Anisophyllum cordatum Klotzsch & Garcke, *ex* Kotzsch, Linn. natürl. Pflanzenkl. Tricocc. Berl. Herb. Allgem. natürl. Ordn. Euphorb., p. 38. 1860.
Chamaesyce Degeneri (Sherff) Croiz. & Deg. *ex* Deg., Fl. Haw. Dec. 9, 1936.

Leaves finally glabrate unless toward base........................*E. Degeneri*
Leaves densely pilose.....................................var. *β. molokaiensis*

Low prostrate undershrub, 3–6 dm. tall; branches thickish, nodose, often tortuous, tomentose, with short to very short internodes. Leaves distichous, subsessile or virtually sessile, orbicular, entire or sometimes very obscurely crenulate, cordate at base, often emarginate at apex, subfleshy, inconspicuously nerved, glabrous or glabrate or toward base slightly hispidulous, mostly 1–2 cm. wide, often finally turning reddish;

stipules low, obtuse, hairy-fringed. Capitula terminal and in upper axils, solitary or more rarely in groups of 3. Involucre subsessile, campanulate-hemispherical, mostly less than 2 mm. long, outwardly glabrous; glands substipitate, somewhat concave, transversely oblong and often bordered with a narrow membranous appendage; lobes ovate, hispid; staminophores exserted, their bractlets deeply slit. Capsule exserted, inclined, ovate, finally glabrate, about 2 mm. long; cocci slightly carinate, inconspicuously salient-punctulate; styles distinct, bifid and at tips of branches somewhat thickened. Seeds oblong, tetragonal, truncate at base, obtuse at apex, white, scrobiculate, ±1.7 mm. long.

Type specimen: Collected by *Dr. Francis Julius Ferdinand Meyen*, no. *62*, "Diamond Hill" (Diamond Head), Oahu, 1831 (Berlin).

Distribution: Along coast, Oahu and northwesternmost Molokai; also at widely scattered spots along coast of Kauai, West Maui, and Hawaii.

Specimens examined: *E. Christophersen 1398*, alt. ±5 meters, in sand, Kaena Point, Oahu, December 14, 1930 (Field, 2 sheets); *Dr. C. Montague Cooke, Jr.*, Laniloa, Oahu, February 1, 1919 (Bishop); *Otto Degener H-220*, coastal sand dune, Waimanalo, Oahu, April 8, 1923 (New York); *Degener 8067 pro parte*, along beach in arid region, near Waiakanapo, Molokai, April 19, 1928 (Degener); *Degener 8068*, arid region near coast, same locality and date (Field); *Degener 8097*, Koko Head, Oahu, October 25, 1926 (Degener); *Degener 8099*, along shore, Niulii, Kohala, Hawaii, March 23, 1930 (Degener; New York); *Degener* (similarly) *8099*, coastal dune, Waimanalo, Oahu, April 8, 1923 (Degener, 2 sheets); *Abbé Urbain Faurie 461*, on shores, Halawa, Hawaii, June, 1909 (Bishop; Delessert; Paris); *Faurie 463*, on shore at Hanapepe, Kauai, December, 1909 (Paris); *Charles N. Forbes*, beach between Diamond Head and Koko Head, Oahu, December 4, 1908 (Field; Missouri); *Forbes* (with *John F. G. Stokes) 316-M*, West Maui, February, 1913 (Bishop); *Forbes 612-Mo*, Moomomi, northwestern Molokai, March 24, 1912 (Bishop); *Forbes 1066-O*, Diamond Head, Oahu, January 26, 1909 (Field); *Forbes 1078-O pro parte*, same locality and date (Field); *Forbes 1649-O*, Kaena Point, Oahu, February 25, 1911 (Field); *Charles Gaudichaud*, Hawaiian Isls., October, 1836 (Delessert; Missouri); *Gaudichaud 286*, same locality, September–October, 1836 (Paris); *Amos Arthur Heller 2019*, Diamond Head, Oahu, March 28, 1895 (Bishop; Cornell; Field, 2 sheets; Gray; Kew; Missouri; New York; Paris; U. S.); *Dr. William Hillebrand*, Honolulu, Oahu (Vienna); *Hillebrand*, Diamond Head, Oahu (Berlin); *Hillebrand*, Kailua, Oahu, 1867 (Berlin); *Hillebrand 47*, Oahu (Kew); *Hillebrand 47-b*, Diamond Head, Oahu (Kew); *Dr. Albert S. Hitchcock 13883*, sand dune near coast, Kahuku, Oahu, June 26, 1916 (U. S.); *Rev. J. M.*

Lydgate, Mahaulepu, Kauai (Bishop); *Vaughan MacCaughey*, Waimanalo, Oahu (Bishop); *MacCaughey 12923*, Koko Head, Oahu (Bishop); *Horace Mann & William T. Brigham 106*, outer slope of Leahi, Oahu (Bishop; Cornell; Field, 3 sheets; Gray; Missouri; New York; U. S.); *Maximowicz*, Oahu (Kew); *Dr. Meyen*, Oahu, 1831 (type, Berlin: cotype, Vienna); *George C. Munro 531*, Moomomi sand hills, northwestern Molokai, July 26, 1922 (Bishop); *Marie C. Neal*, on beach, Kawailoa, Oahu, July 14, 1929 (Bishop); *Jules Remy 589*, Oahu, 1851–1855 (Field; Paris); *Joseph F. Rock*, Moomomi beach, northwestern Molokai, March, 1910 (New York); *Rock 7078 pro parte*, same locality and date (Bishop; Field; Gray; New York); *Rock 10100*, Waialua beach, Oahu, May, 1911 (Field; Gray); *Harold St. John 9983*, Kaena, beach 2 miles west of Kawaihapai, Oahu, November 3, 1929 (New York); *John F. G. Stokes*, Molokai, 1909 (Bishop); *D. LeRoy Topping 3294*, Kawela Bay, Oahu, October 9, 1926 (Degener); *United States Exploring Expedition*, Diamond Head, Oahu, 1840 (Gray; Missouri; U. S.); *Dr. Heinrich Wawra 2344*, Hawaiian Isls., 1868–1871 (Vienna); *Gerrit Parmile Wilder 87*, sandy seacoast, Kailua, Oahu, April 7, 1924 (Bishop).

Euphorbia Degeneri var. β. **molokaiensis** Sherff, Bot. Gaz. **97**: 583. 1936. (Pl. 11.)

Leaves and capsules velvety-pilose.

Type: Collected by *Joseph F. Rock*, no. *7078 pro parte*, Moomomi, Molokai, March, 1910 (Gray).

Distribution: Near coast, northwestern Molokai.

Specimens examined: *Otto Degener 8067 pro parte*, along beach in arid region, near Waiakanapo, Molokai, April 19, 1928 (Degener; Field, 2 sheets); *Rock 7078 pro parte* (type, Gray: cotype, Vienna; cotype fragment, Field).

15. **Euphorbia hirta** L., Sp. Pl., p. 454. 1753.

Euphorbia pilulifera of many authors, not of the Linnean Herbarium (*fide* N. E. Brown) nor of the Linnean description (for various additional synonyms and critical notes pertaining to the Linnean concept, see N. E. Brown *in* Thiselton-Dyer, Fl. Trop. Afr. **6**, pt. 1: 496. 1911; but *cf.* Farwell, Rhodora **38**: 332. 1936).

Annual herb, 1–4 dm. tall; stems erect or decumbent at base, simple or dichotomously branched, long-pilose (hairs spreading, yellowish, several-celled, attenuate, upper ones subnumerous, lower ones remote or almost lacking) and in addition more or less pubescent (with diminutive hairs, these arcuate and subappressed). Leaves opposite, petiole 1–3 mm. long; blade obliquely lanceolate or ovate or rhomboid-oblong, at apex acute or subobtuse, at base rounded on one side and cuneate on the

other, at margin serrulate, membranaceous, on both surfaces sparsely (or underneath scarcely) appressed-hispid (hairs on upper surface longer), 1–4 (more rarely –5) cm. long and 0.5–2 cm. wide; stipules separate, minute, subulate. Cymes axillary, pedunculate, 6–13 mm. in diameter, globose or divided into 2 or 3 subglobose heads; peduncle minutely pubescent (hairs arcuate, whitish, subappressed), 2–12 mm. long. Capitula numerous. Involucre staminate or hermaphroditic, minute (about 0.7 mm. tall), obconic or suburceolate, on outer surface sparsely or subdensely (more or less appressed-) hispid; glands 4 (the 5th replaced by a sinus through which passes the recurved stipe of the fruiting capsule), erect, a little longer than the lobes, linear when viewed sidewise, orbicular or oblong-orbicular (when viewed from above) at the truncate apex, bearing a minute rounded dorsal appendage just below the apex; lobes 5, deltoid, acute, hairy-fringed (seemingly fimbriate). Capsule globose-trigonous, sparsely or densely appressed-hispid, less than 0.8 mm. tall; cocci definitely carinate; styles short, deeply bifurcate into slender branches, these truncate and somewhat thickened at apex. Seeds oblong, tetragonal, reddish, at base subtruncate at apex obtuse, about 0.65–0.75 mm. long, the faces transversely somewhat rugulose.

Type: Probably from British East India *(cf.* Linnaeus, *loc. cit.).* It is still extant (Linnaeus; *cf.* N. E. Brown, *loc. cit.,* p. 497).

Distribution: A widely spread weed occurring throughout the tropics and found also in some subtropical regions; now common on all or most of the Hawaiian Islands.

Specimens examined: *Frederick Debell Bennett 64,* Oahu, 1833–36 (Berlin); *Edward L. Caum 13,* Lehua (an islet near Niihau), April 18–20, 1931 (Bishop); *D. R. Chisholm,* Midway Isl., December, 1931 (Bishop); *Otto Degener 9112,* weed in dry locality, University of Hawaii Campus, Honolulu, Oahu, November, 1926 (New York); *"Mr. Deell,"* Byron's Bay (i. e., Hilo Bay), Hawaii (Paris); *Rev. John Diell 100,* Oahu (Kew); *Abbé Urbain Faurie 516,* in herb-grown places, Halawa, Hawaii, June, 1909 (Paris); *Charles N. Forbes,* Museum Grounds, Honolulu, Oahu, July 15, 1908 (Bishop); *Forbes,* Honolulu, same date (Missouri); *Forbes,* slopes of Puu Kaala, Mokuleia, Oahu, April 26–May 16, 1912 (Field); *Forbes 7-H,* Puuwaawaa, Hawaii, June 8–14, 1911 (Bishop); *Forbes 471-K,* roadsides, Lihue, Kauai, October 4, 1916 (Bishop); *Forbes 1022-O,* Museum grounds, Honolulu, Oahu, January 15, 1909 (Bishop; Missouri); *Forbes 1075-O,* up and

around Diamond Head, Oahu, January 26, 1909 (Bishop); *D. Wesley Garber,* Old Naval Station, Honolulu, Oahu, October 16, 1919 (Bishop); *E. S. Handy,* near the landing, Niihau, August 14, 1931 (Bishop); *Amos Arthur Heller 1980,* "in and on the slopes of Makiki," Oahu, March 21, 1895 (Field; Kew; Missouri; New York; Paris; U. S.); *Heller* (similarly) *1980,* Honolulu, Oahu, March 22, 1895 (Bishop; Cornell; Field); *Heller* (similarly) *1980,* same place, March 27, 1895 (Field); *Albert S. Hitchcock 13685,* Honolulu, Oahu, June 15, 1916 (U. S.); *Hitchcock 15144,* sandy beach, West Molokai, October 12, 1916 (U. S.); *Edward P. Hume,* Kalihi Street, near Bishop Museum, Honolulu, June 10, 1931 (Bishop); *Hume 168,* alt. 30 meters, dry place at seaside, Koko Head, Oahu, January 24, 1931 (Bishop); *Lay & Collie* (Capt. Beechey's Voyage), Oahu, 1826–27 (Kew); *Horace Mann & William T. Brigham 35,* garden and roadside weed, Oahu (Bishop; Cornell; Missouri); *Charles F. Millspaugh 2587 and 2588,* Oahu, September 12, 1911 (Field); *George C. Munro 318,* Koele, Lanai, November 2, 1913 (Bishop); *Marie C. Neal,* Rabbit Island, Oahu, March 16, 1930 (Bishop); *Neal,* alt. 15–25 ft., rocky slope in gully, close to ocean, fresh-water seepage, Koko Crater, Oahu, January 18, 1931 (New York); *Jules Remy 590, Oahu,* 1851–1855 (Paris); *Remy 597,* same locality and date (Paris); *Joseph F. Rock,* Parker Ranch, Hawaii, June, 1909 (Bishop); *Rock 754,* Punaluu Railroad Station, Oahu, December 3, 1908 (Bishop); *John F. G. Stokes,* south half of Niihau, January, 1912 (Bishop).

16. **Euphorbia Hypericifolia** L., Sp. Pl., p. 454. 1753.

Chamaesyce Hypericifolia Millsp., Field Mus., Bot. Ser. **2:** 302. 1909.

Euphorbia bifida Hook. & Arn. *ex* St. John & Hosaka, Weeds Pineapple Fields Haw. Isls. (Univ. Haw. Res. Publ. 6), p. 105, and *plate* (p. 104). 1932 (not Hook. & Arn., Bot. Beech. Voy., p. 213. 1836). (For other synonyms and critical notes see Boiss. *in* DC., Prodr. **15,** pt. 2: 23. 1862; also N. E. Brown *in* Thiselton-Dyer, Fl. Trop. Afr., **6,** pt. 1: 498. 1911.)

Annual herb, erect, erectly branched from base or at times simple, 0.7–4.5 dm. tall; the simple or alternately branched stems glabrous or slightly pubescent. Leaves opposite, petiole slender but very short (1–2 mm.); blade variously oblong or linear-oblong to oblong-lanceolate elliptic or ovate, at apex subacute to rounded, at base oblique, marginally serrulate (the tiny teeth more or less spinulose) or rarely entire, membranaceous, glabrous or on one or both surfaces somewhat pubescent, 0.6–3.8 cm. long and 4–18 mm. wide; stipules highly variable but often partly or wholly connate into a single interpetiolar narrowly triangular erect supernally diaphanous apically

somewhat fimbriate extension ±3 mm. tall. Cymes axillary, loosely few- to many-capitulate, 0.4–1.9 cm. in diameter; peduncles glabrous or slightly puberulous, 3–18 mm. long, often with a pair of leaves at apex; bracts lanceolate, acuminate, ciliate or entirely glabrous, 1–1.5 mm. long. Involucre obconic to campanulate, glabrous or puberulous, about 1 mm. tall, shortly pedicellate; glands 4, orbicular or transversely elliptic, inconspicuous because of the large white or finally somewhat pinkish petaloid appendages (these transversely elliptic or oblong, 0.5–0.7 mm. broad, entire); lobes 5, deltoid-subulate, ciliate. Capsule depressed-globose, trigonous, glabrous or puberulous, about 1.2 mm. tall and about 1.5 mm. thick, cocci carinate; styles slender, distinct to base, deeply bifurcate. Seeds oblong-ellipsoid to oblong-ovoid, tetragonal, reddish-brown or overcast with a grayish-white or glaucescent hue, somewhat transversely rugulose, about 0.8–0.9 mm. long.

Type: Probably came from British East India (Linnaeus).

Distribution: Widely distributed throughout all warm regions. St. John and Hosaka (Weeds of the Pineapple Fields Haw. Isls., p. 105. 1932), under *their* synonymous, "*E. bifida* H. & A.," describe the occurrence for the Hawaiian Islands as follows: "found in dry and in moderately moist places. East and south Kauai: abundant; Oahu: abundant; Molokai: occasional; Lanai: common; east and west Maui: common; Hawaii: occasional."

Specimens examined: *Charles N. Forbes*, roadsides, Manoa Valley, Oahu, January, 1913 (Bishop); *Forbes 2445-O*, roadside near Niu, Oahu, April 5, 1917 (Field, 2 sheets); *Albert S. Hitchcock 13913*, weed on edge of sugar-cane field, Schofield Barracks, Oahu, June 30, 1916 (U. S.); *Hitchcock 14079*, along roadside, Manoa Valley, Oahu, August 1, 1916 (U. S.); *A. F. Judd 56*, near government road, Wahiawa, Oahu, July 19, 1926 (Bishop); *Mr. Pope 3*, Honolulu, Oahu, August, 1924 (Bishop).

17. **Euphorbia Thymifolia** L., Sp. Pl., p. 454. 1753.

Anisophyllum Thymifolium Klotzsch & Garcke *ex* Klotzsch, Linn. natürl. Pflanzenkl. Tricocc. Berl. Herb. Allgem. natürl. Ordn. Euphorb., p. 25. 1860. (Various other synonyms omitted here.)

Annual herb; stems several or many, filiform, prostrate, very

much branched, curly-haired, mostly 1–2 dm. long. Leaves opposite, the petiole ±0.4 mm. long; blade oblong, at apex obtuse, at base suboblique, at margin serrulate-crenulate, glabrous or more often on lower surface appressedly hirtous, mostly 3–7 mm. long; stipules elongately lanceolate-subulate, hairy-fimbriate. Capitula axillary, mostly congested upon much-abbreviated axillary racemes. Involucre turbinate, outwardly appressed-hirtous but inwardly (except for the short and ciliolate lobes) glabrous, deeply cleft, under 1 mm. long; glands very minute, stipitate, ovate-rounded, with an equally wide or narrower and 2–3-lobulate appendage; pedicel usually less than half as long as involucre, sparsely hirsute. Capsule very shortly stipitate and even when young not cernuous, ovoid, appressed-hirtous, about 1 mm. tall; cocci obtusely carinate; styles distinct, slender, ±0.5 mm. long, deeply bifurcate. Seeds oblong-tetragonal, reddish, transversely 4–5-sulcate, about 0.6 mm. long.

Type: See discussion.

Distribution: Adventive from the Old World; known only from Oahu and Kauai.

Specimens examined: *Abbé Urbain Faurie 488 pro parte*, Kapoho, Kauai, May, 1909 (Delessert; a second sheet of this number is of true *E. prostrata*); *D. Wesley Garber 5*, Old Naval Station, Honolulu, Oahu, October 16, 1919 (Bishop).

Most material heretofore referred to *E. Thymifolia* is seen to belong to *E. prostrata*. The *Garber* material, however, was very kindly submitted for me by Sir Arthur W. Hill, Director of the Royal Botanical Gardens of Kew, to Dr. J. Hutchinson of the Kew Herbarium, and Sir Arthur now writes: "The *Euphorbia* . . . has been compared very carefully with the type of *Euphorbia Thymifolia* L. in the Linnean Herbarium at Burlington House, and with our Indian material, and Dr. Hutchinson considers it to be this species."

18. Euphorbia prostrata Aiton, Hort. Kew. **2**: 139. 1789. (For various synonyms see Boiss. *in* DC., Prodr. **15**, pt. 2: 47. 1862.)

Annual herb, stems several, prostrate, slenderly filiform, alternately branched, puberulous with minute curved hairs

on upper (dorsal) side at least along median line, glabrous beneath (ventrally), 0.5–2 dm. long. Leaves opposite, petiole glabrous and ±1 mm. long; blade oblong to elliptic or slightly oblong-obovate, at apex obtuse to rounded, at base oblique, at margin distinctly or obsoletely denticulate and sometimes ciliate, glabrous on both surfaces or on lower surface sparsely puberulous especially toward apex, 2–6 mm. long; stipules on upper side of stem usually distinct linear and pilose, those on lower side united into one deltoid or deltoid-ovate body, this apically laciniate-toothed. Capitula in short axillary leafy racemiform clusters, with 1 axillary capitulum to each pair of reduced leaves; or clusters at times reduced, with 1–3 capitula on a short peduncle, and with 1–3 pairs of minute spatulate leaves. Involucre campanulate or elongate-turbinate, glabrous or very slightly puberulous, 0.5–0.65 mm. long; glands 4, minute, suborbiculate, appendage very narrow or obsolete; lobes 5, ovate, pectinate-ciliate; pedicel glabrous, 0.5–1 (here and there one up to 2.5) mm. long. Capsule cernuous, subovate-orbiculate in side view, along and sometimes near the acute angles whitish-ciliate, otherwise mostly very glabrous, about 1.1–1.2 mm. tall; styles distinct, exceedingly short (only about 0.15 mm. long), deeply bifurcate, the branches thickened at apex. Seeds narrowly ovoid, truncate at base, obtuse at apex, tetragonal, at first reddish but finally grayish, ±0.8 mm. long, the faces transversely 5–7-sulcate.

Type specimen: Cultivated by Philip Miller in 1758, from seed obtained in the West Indies. Not seen by me but probably still extant (British or Kew).

Distribution: Native of tropical America but now widely spread in other warm parts of the earth; in Hawaiian Islands found on Kauai, Oahu, Lanai, West Maui, Kahoolawe, and doubtless elsewhere.

Specimens examined: *Abbé Urbain Faurie 486,* in fields, Honolulu, Oahu, April, 1909 (Bishop; Paris); *Faurie 488 pro parte,* Kapoho, Kauai, May, 1909 (Delessert); *Charles N. Forbes,* Kahoolawe, February 10–March 10, 1913 (Bishop); *Forbes 83-M,* Napili, West Maui, May, 1910 (Bishop); *Forbes 1023-O,* Honolulu, Oahu, January 15, 1909 (Bishop; Missouri); *Amos Arthur Heller 1981,* Makiki, Oahu, March 21, 1895 (Field; Gray; Kew; Missouri; New York; Paris, 2 sheets; U. S.); *Albert S. Hitchcock 13717,* rocky soil near stream, Honolulu, Oahu, June

15, 1916 (U. S.); *George C. Munro 197* and *289*, Koele, Lanai, November 2, 1913 (Bishop); *John F. G. Stokes*, Popoia (islet near Kailua, Oahu), November, 1915 (Bishop).

Most of the material in the Hawaiian Islands which has passed heretofore for *Euphorbia Thymifolia* L. is referable to this species.

Section 2. POINSETTIA (Graham) Boissier

Sect. 2. POINSETTIA (Graham) Boissier *in* DC., Prodr. **15**, pt. 2: 10. 1862; genus *Poinsettia* Graham, Edinburgh New Philosoph. Journ. **20**: 412. 1836.

Our species introduced; erect annuals. Leaves entire, dentate, or sinuate, all or only upper ones opposite, the uppermost often colored, especially near base. Stipules reduced to small glands. Capitula in terminal clusters. Glands 3 or 4 or more, often solitary, somewhat cup-shaped; lobes 4 or 5, deeply fimbriate-toothed. Interfloral bracteoles fimbriate-lacerate. Seeds ecarunculate or very minutely carunculate.—Nos. 19–20.

19. Euphorbia heterophylla L., Sp. Pl., p. 453. 1753.

Euphorbia heterophylla var. *genuina* Boiss. *in* DC., Prodr. **15**, pt. 2: 72. 1862.

Poinsettia heterophylla Klotzsch & Garcke *ex* Klotzsch, Linn. natürl. Pflanzenkl. Tricocc. Berl. Herb. Allgem. natürl. Ordn. Euphorb., p. 104. 1860.

Poinsettia Edwardsii Klotzsch & Garcke *ex* Klotzsch, *loc. cit. (fide Boiss., loc. cit.).*

Only the upper leaves pandurate.............................*E. heterophylla*
Lower leaves mostly pandurate, upper ones commonly pandurate or querciform
....var. *β. cyathophora*

Annual or at times biennial or perennial, erect, bright green, pubescent to subglabrous, 3–9 dm. tall; stem simple or branched, woody below, the branches ascending or lower ones spreading, leafy at their ends. Leaves alternate except for topmost ones, the slender petiole more often 1–4 cm. long; blade polymorphous, thin, commonly 3–8 cm. long, that for lower and median leaves ovate or rhombic-oblong or lanceolate-

linear, its margin entire or undulate or even irregularly dentate or sinuate; that for the upper or floral leaves broader and dentate or often panduriform and blotched with purple or red; stipules reduced to small glands. Inflorescence of corymbulose and somewhat dense cymes, these subtended by the uppermost leaves. Involucre campanulate or cup-shaped, glabrous, about 2–2.3 mm. tall; glands 1 or few, exappendiculate, substipitate, in sinuses of the 5 ovate to oblong fimbriate lobes; pedicel short (usually about 0.5–0.6 the involucre's length), glabrous. Capsule glabrous or minutely pubescent, cernuous on a short glabrous stipe, about 4 mm. tall and somewhat thicker; cocci plump, the keel a mere line. Seeds oblong-ovoid, subterete, blackish but densely covered with grayish-brown tubercles (the larger of these sometimes dilated and appearing somewhat crested), ecarinate.

Type: Not seen by me.

Distribution: In the United States from Illinois and Minnesota south to Florida and Texas; in Mexico, Central America, Bolivia, and various other warm regions; in the Hawaiian Islands apparently represented only by the variety *cyathophora.*

Specimens examined: None (that is, from Hawaiian Islands).

Probably not yet adventive in the Hawaiian Islands, although erroneously so cited by many authors. Thus, for example, Hillebrand remarked in 1888 (Fl. Haw. Isls., p. 398) that *Euphorbia heterophylla* L. had been collected by him many years before in the upper parts of Nuuanu, Oahu, but that he had not met with it since. Of the somewhat similar *E. geniculata* Ort. he wrote, "which showed itself in gardens of Honolulu before my departure." *Hillebrand 43,* labeled by him "*Euphorbia* (naturalized?) Nuuanu Valley Oahu," had been received at Kew in July, 1865, and was determined by someone as *E. heterophylla* L. Its strongly carinate seeds show it to be *E. geniculata,* however. And, from the fact that *E. geniculata* was reported by Hillebrand only as having shown itself in gardens at Honolulu before his departure (in 1871), it is clear that the Kew specimen must represent the basis of his citation of

E. heterophylla L. (the more so because his own herbarium as it is preserved today at Berlin is seen to lack a specimen of his *E. heterophylla,* indicating that he probably depended upon notes which he had taken long before).

Degener (Fl. Haw., June 30, 1932) misinterprets Hillebrand's *E. heterophylla* as referring in reality to the var. *cyathophora* (treated below). However, that variety differs sharply not only in its mostly pandurate leaves (the floral ones commonly purplish- or reddish-splotched) but in its more rounded, ecarinate seeds.

Euphorbia heterophylla var. β. **cyathophora** (Murray) Grisebach, Fl. Brit. West Ind., p. 54. 1859; *cf.* Boiss. *in* DC., Prodr. **15**, pt. 2: 72. 1862.

Euphorbia cyathophora Murray, Comm. Goett. **7**: 81, *tab. 1.* 1786.

Poinsettia cyathophora Klotzsch & Garcke *ex* Klotzsch, Linn. natürl. Pflanzenkl. Tricocc. Berl. Herb. Allgem. natürl. Ordn. Euphorb., p. 104. 1860; Degener, Fl. Haw., description and plate, June 30, 1932.

Leaves mostly pandurate with 2 or 4 obtuse but often acutely tipped lobes, rarely some basal ones ovate, uppermost ones at times less pandurate and somewhat more querciform.

Type: Not seen by me but represented by the type plate (Murray, *loc. cit.).*

Distribution: Native of tropical America but now naturalized in various other warm parts of the earth; established in recent years on Oahu.

Specimens examined: *Otto Degener 2491,* roadside, Kaimuki, Oahu, February 3, 1928 (New York); *Degener 3008,* along coast in arid region, Waimea, Oahu, July 9, 1926 (Missouri; New York); *Charles N. Forbes 2443-O,* roadsides at Kaimuki, Oahu, April, 1917 (Bishop).

20. **Euphorbia geniculata** Ortega, Nov. Rar. Pl. Hort. Matr. Decad., p. 18. 1797. (For various synonyms see Boiss. *in* DC., Prodr. **15**, pt. 2: 72. 1862.)

Similar to *E. heterophylla,* but somewhat coarser; leaf blades not pandurate or quercine, mostly oblong or ovate (often subrhomboidally so), acute or acuminate at apex, entire

or obsoletely (sometimes near base definitely) dentate, floral ones not purplish- or reddish-splotched; involucre cylindric-turbinate, very shortly pedicellate; lobes 5–7, oblong-lanceolate; seeds slightly larger (about 3–3.2 mm. long), more angular and on outer face carinate, less densely tuberculate.

Type specimen: Not seen by me.

Distribution: Texas, northern Mexico, West Indies, etc. Now established on Hawaii, Oahu, Kauai (Waimea, *fide* Heller, Minn. Bot. Studs. **1**: 845. 1897), Niihau, and perhaps elsewhere.

Specimens examined: *Edwin H. Bryan, Jr.*, roadside weed, Schofield Road, Oahu, February 10, 1929 (New York); *Bryan 701*, side of trail, Hauula, Oahu, April 14, 1929 (Bishop); *Otto Degener 1635*, corn field, Manoa Valley, Honolulu, Oahu, September 25, 1922 (New York); *Abbé Urbain Faurie 475*, in gardens, Halawa, Hawaii, June, 1909 (Delessert; Paris); *Faurie 517*, Honolulu, Oahu, November, 1909 (Bishop; Paris); *Charles N. Forbes*, Nuuanu Valley, Oahu, March 21, 1909 (Bishop; Field; Missouri); *Forbes 1623-M*, Manawainui, south slope of Haleakala, Maui, March 3, 1920 (Field); *Forbes* (with *J. C. Bridwell*) *2441-O*, Waiolae Iki, Oahu, March 2, 1917 (Bishop); *Amos Arthur Heller 2035*, Nuuanu, Oahu, March 29, 1895 (Cornell; Field, 2 sheets; Gray; Kew; Missouri; New York; U. S.); *Heller* (similarly) *2035*, same locality, November 6, 1895 (Paris); *Albert S. Hitchcock 13699*, Honolulu, Oahu, June 15, 1916 (U. S.); *E. P. Hume 55*, University of Hawaii Campus, Honolulu, November 15, 1930 (Bishop); *Dr. Charles F. Millspaugh 2586*, Oahu, September 12, 1911 (Field); *George C. Munro 453*, Honolulu, Oahu, 1916 (Bishop); *Munro 636*, Oahu, 1916 (Bishop); *Marie C. Neal*, roadside, Makiki Valley, Oahu, March 13, 1932 (Bishop); *Joseph F. Rock 780*, Punaluu station, Oahu, December 3–14, 1908 (Bishop); *Harold St. John 9999*, thicket, Uluhulu Gulch, Kaena, Oahu, November 3, 1929 (Bishop); *John F. G. Stokes*, south half of Niihau, January, 1912 (Bishop, 2 sheets, one of more hairy material).

Section 3. Tithymalus (Adanson) Boissier

Sect. 3. Tithymalus (Adanson) Boissier *in* DC., Prodr. **15**, pt. 2: 10. 1862; genus *Tithymalus* [Tournefort] Adanson, Familles des Plantes **2**: 355. 1763.

Ours a single, introduced species, with capitula in a terminal, umbelliform inflorescence; stipules absent; glands long-horned; cocci 2-wing-crested on back; seeds carunculate.—No. 21.

21. Euphorbia Peplus L., Sp. Pl., 456. 1753. (For various synonyms see Boiss. *in* DC., Prodr. **15**, pt. 2: 141. 1862; also

J. B. S. Norton, Ann. Rept. Mo. Bot. Gard. **11:** 113, *pl. 30.* 1900.)

Annual herb, stem erect or ascending, 1.5–3 dm. tall, many branches from the base and below the umbel, the lower branches often almost as high as the plant axis, striate. Cauline leaves opposite except for the verticillate ones subtending the umbel, petiolate, the slender petiole up to 1 cm. long; blade obovate to rotund, apically obtuse to truncate or retuse, basally cuneate-narrowed, extremely thin, crisped, 0.5–2.5 cm. long and 0.4–1.2 cm. wide; floral leaves (bracts) opposite, sessile, smaller, more or less ovate or slightly pandurate, basally somewhat oblique, obtuse at both ends, sometimes mucronate, 0.6–1.5 cm. long and 0.5–1 cm. wide. Stipules none. Umbel 3- or sometimes up to 5-rayed, then forking. Involucre campanulate, about 1 mm. tall; glands 4, crescentic, much prolonged at each end into a slender horn; lobes triangular-ovate, hispid-ciliate; pedicel short; stamens 10–15, exserted. Capsule globose-ovoid to rarely depressed-globose, glabrous, slightly cernuous, about 2 mm. tall, deeply 3-parted; cocci very narrowly alate-bicarinate on back; styles distinct, up to 0.5 mm. long, deeply bilobed. Seeds oblong or oblong-ovoid, whitish, about 1.3 mm. long and 0.8 mm. wide, subhexagonal, the two inner faces each with a large lengthwise depression, the four external faces each with 1–4 (mostly 3) commonly large shallow pits in longitudinal rows, sometimes additional pits between the rows, or even 6 rows; caruncle conical, white. (Description in small part from Norton, *loc cit.)*

Type: The Linnean concept was founded upon various earlier citations in literature.

Distribution: Native of Europe but now found elsewhere; in the Hawaiian Islands known from Hawaii, East Maui, and southern Kauai.

Specimens examined: *Otto Degener,* 17 miles along main road from Kohala toward Waimea, Hawaii, August 13, 1926 (New York); *Degener 9105,* pasture, Honokaa, Kohala, Hawaii, July 28, 1926 (New York); *Abbé Urbain Faurie 464,* fields, Koloa, Hawaii, June, 1909 (Bishop; Delessert; Paris); *Charles N. Forbes,* Makawao, East Maui, August, 1910 (Field; Missouri); *Forbes 202-H,* summit of Hualalai, Hawaii, June 19–21, 1911 (Bishop); *Forbes 1989-M,* Kanaio, south slope of Haleakala, East Maui, March 1, 1920 (Field); *Amos Arthur Heller,* along Hana-

pepe River near the Falls, Kauai, June 24–26, 1895 (Field); *Dr. William Hillebrand,* Kona, Hawaii (Berlin; U. S.); *Albert S. Hitchcock 14218,* ravine, alt. 3600 ft., Kukaiau Ranch, Hawaii, August 19, 1916 (U. S.); *Horace Mann & William T. Brigham 333,* high central plateau of Hawaii, 1864–1865 (Cornell); *Jules Remy 599, Hawaii,* 1851–1855 (Paris).

Explanation of Plate

PLATE 2

Euphorbia Remyi var. *molesta* (first type sheet).

SHERFF — HAWAIIAN EUPHORBIAE

Explanation of Plate

PLATE 3

Euphorbia halemanui (type).

SHERFF — HAWAIIAN EUPHORBIAE

EXPLANATION OF PLATE

PLATE 4

Euphorbia Celastroides var. *moomomiana* (first type sheet).

SHERFF — HAWAIIAN EUPHORBIAE

EXPLANATION OF PLATE

PLATE 5

Euphorbia Celastroides var. *kaenana (Degener, Hirai & Park 8038,* in Herb. Degener).

SHERFF — HAWAIIAN EUPHORBIAE

Explanation of Plate

PLATE 6

Euphorbia Celastroides var. *halawana* (type).

SHERFF — HAWAIIAN EUPHORBIAE

Explanation of Plate

PLATE 7

Euphorbia Celastroides var. *hanapepensis* (type).

SHERFF — HAWAIIAN EUPHORBIAE

EXPLANATION OF PLATE

PLATE 8

Euphorbia Celastroides var. *amplectens* (type).

SHERFF — HAWAIIAN EUPHORBIAE

EXPLANATION OF PLATE

PLATE 9

Euphorbia multiformis var. *tomentella* (type).

SHERFF — HAWAIIAN EUPHORBIAE

Explanation of Plate

PLATE 10

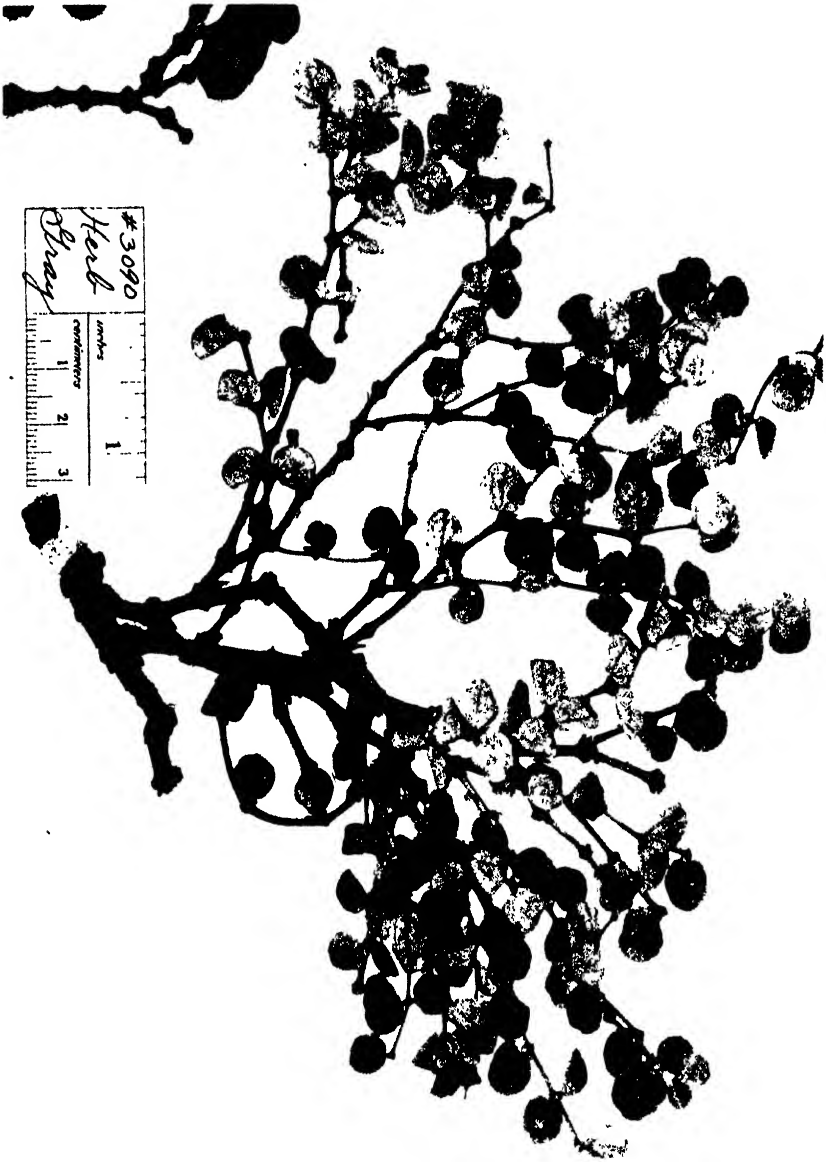
Euphorbia Skottsbergii var. *kalaeloana* (first type sheet).

SHERFF — HAWAIIAN EUPHORBIAE

Explanation of Plate

PLATE 11

Euphorbia Degeneri var. *molokaiensis* (type).



SHERFF — HAWAIIAN EUPHORBIAE

THE CALIFORNIAN SALVIAS

A Review of Salvia, Section Audibertia

CARL EPLING

Associate Professor of Botany, University of California, Los Angeles

FOREWORD

The Salvias which are confined largely to the Californian area are of interest because of the association with them of most of the students of the California flora. Few of the older California botanists but were the discoverers in the field or describers in the herbarium of one or more of these interesting plants. Earliest and foremost were George Bentham, David Douglas, and Asa Gray, and it is largely to these that the section owes its present content. More recently Professor Munz has contributed an authoritative revision, which, save for extensions in range due to recent explorations and the discovery of numerous natural hybrids, would render this work superfluous. Where not otherwise apparent I have sought to indicate by subsectional names the principal students of the group.

The historical aspect of the group is not its sole source of interest, however, fascinating as that backward vista may be. Two other phases present themselves and offer an ever-widening avenue of investigation into the future: the rôle which the group plays in plant economy, and the method of speciation which has prevailed within it. But scant reference may be made to either of these subjects in this paper since both are but little explored.

Confined as they are to arid portions of the Southwest, the Audibertias are components primarily of two shrub formations —the *Larrea-Franseria* formation of the Colorado Desert, and the related *Artemisia californica-Salvia* formation of the coastal plain. Seven species are conspicuous localized elements in the former; five species are important or dominant elements in the latter. The remaining six species are either ubiquitous

Issued December 27, 1937.

or are associated with a formation contiguous to those mentioned. Ignoring the ubiquitous *S. Columbariae,* two species enter into the desert woodland *(Pinus-Juniperus)* in association with *Artemisia tridentata,* and one enters into the valley woodland *(Quercus-Pinus),* often in association with *Artemisia californica.* Two enter into the drier aspects of the chaparral (chamisal). But the greatest impress is made in the coastal sage formation *(Artemisia californica),* ranging along the coastal plain and in the foothills of the coastal ranges from the Bay region in central California to Rosario in Lower California. Here one species or another may be the dominant and sometimes seemingly sole species for thousands of acres. Because of its low elevation and relatively gentle slope as well as the peculiarities of its climate, this formation has been the one chiefly occupied by man. It is accordingly the one most modified. In southern California the citrus industry is closely correlated with the coastal sage formation. Perhaps this disturbance of the original formation has resulted in more species coming together and consequently more frequent crossing.

There is, then, an abundant body of facts relating to the distribution of these plants, even though their significance may not be understood; one may only surmise the course of speciation and the factors involved. When one considers the remarkable uniformity of flower structure which is seen in the large section Calosphace (470 species or more) the Audibertias appear heterogeneous. In habit there is a tremendous range between *S. carduacea* and *S. apiana* or between *S. Columbariae* and *S. spathacea.* In flower structure the seemingly fundamental and significant structure of the stamens presents an even wider range when one compares those of *S. carduacea* (anthers sessile, the connective divaricate, both thecae fertile) with those of *S. apiana* (half the anthers suppressed, the filament well developed). Here would appear to be ample justification for generic segregation, as was suggested by Greene (the genus *Ramona).* Yet one may proceed step by step from one extreme to the other. What is more significant, the species suggest interchanges of blocks of characters. *S. Munzii* has roughly the foliage of *S. Clevelandii,* the flowers of *S. mellifera.*

S. Brandegei has the flowers and inflorescence similar to *S. mellifera,* the foliage of *S. eremostachya.* *S. Vaseyi* suggests an intermediate condition between *S. apiana* and *S. eremostachya.* And so throughout the whole group blocks of characters reappear in different combinations. The only possible explanation of these facts which occurs to me is that these species have all arisen through hybridization. Such an explanation is given substance by reason of the frequency with which natural hybrids occur: usually when any two species grow together, particularly of the groups Munzia and Jepsonia. Such hybrids are described in the body of the paper. In no sense whatever do the species suggest origin from a single differentiating stock.

It is equally undesirable to hazard a guess as to the origin of the group. Within *Salvia* it appears to be most nearly related to Calosphace, both morphologically and geographically. Within that intricate complex of nearly 500 known species only two species suggest to me a possible connection with Audibertia: *S. axillaris* and *S. clinopodioides.* The corolla and stamens of the former (but not the calyx nor yet the general habit) stand apart from the rest of the section and are suggestive of those of *Salvia spathacea.* The habit of *S. clinopodioides* and particularly the calyx set it off from most of the section Calosphace and are suggestive again of the habit and calyces of *S. spathacea.* Whether these resemblances are genetic or the result of independent and parallel developments it is difficult to say.

To explore adequately these avenues as well as that of the pollination mechanisms will require prolonged studies. Meanwhile the present paper may be considered an introduction. It is based upon an examination of practically all of the extant collections both in this country and abroad and upon a field knowledge extending over a decade or more in which most of the species have been visited throughout their total area of distribution. None but has been studied in the field and most species in the garden as well.

As always, the author is under great obligations to the keepers of the various herbaria here and abroad who so gen-

erously lend valuable material for study. He is particularly under obligations to Dr. Philip A. Munz, Mr. Frank Gander, Mr. French Gilman, and Mr. Joseph Ewan for helpful suggestions and data as to occurrence. He is greatly indebted to Dr. Elbert Ahlstrom for assistance in reading manuscript and proof and checking of bibliographical references. He is under especial obligations to the artist, Mr. Alexander Chudom, whose illustrations require no commendation to be appreciated. These have been prepared by him from living material with the exception of *S. californica* and *S. Brandegei*. Drawings of the flowers were made by the author from living plants and copied in wash by the artist. The calyces are shown without pubescence. The outline maps show the approximate limits of each species in so far as known. The author is further indebted to Mr. William Stewart for pollen smears of several species and hybrids. His obligations should also be recorded to Mr. J. E. Harding for his courtesy at El Arco no less than to Mr. N. R. Vail for his hospitality on Santa Rosa Island.

The chief prior treatments are as follows:

Bentham, G., Lab. Gen. et Sp. 312. 1833, and in DC. Prodr. **12**: 358. 1848.

Gray, A., Syn. Fl. N. Am. **2**: 372. 1878.

Jepson, W. L., Manual Calif. 867. 1925.

Munz, P. A., in Bull. S. Calif. Acad. Sci. **26**: 17. 1927, and in Bot. S. Calif. 443. 1935.

Sect. Audibertia

Audibertia Benth. in Bot. Reg. **17**: 1469. 1831, based upon *A. incana* (not Benth., op. cit. **15**: 1282. 1829).

Ramona Greene in Pittonia **2**: 235, 301. 1892, based upon *Audibertia polystachya* Benth., Lab. Gen. et Sp. 314. 1833.

Audibertiella Briq. in Bull. Herb. Boiss. **2**: 73. 1894, based upon *Audibertia* Benth., loc. cit.

Annual herbs or shrubs clothed with either simple or branched hairs and usually sprinkled with sessile glistening droplets, less often with stalked glands; leaves quite variable

in size and form, often deltoid-oblong, even hastate, often oblong-elliptical or obovate, rarely rotund or spatulate, rarely pinnatifid, prevailingly bullate-rugose, their margins crenulate or entire, commonly whitened or ashy, seldom entirely glabrous; flowers usually numerous in compact glomerules which are disposed in moniliform spikes, these simple or branched, or frequently solitary and capitate, few-flowered and forming an elongated showy thyrsis in one species or even a thyrsoid spike, subtended by numerous bracts which are usually involucrate, less often few in the axils of the upper leaves and subtended by small bractlets; calyx tubular or turbinate, rarely subequally dentate, the posterior three teeth usually united into a gibbous upper lip which is entire, trimucronate, or even aristate at the tip, the two lower teeth small, free, or more or less united with the upper lip, usually acuminate, even aristate, completely united with the upper in one species, the orifice thus truncate and oblique; corolla-tube cylindrical, flaring somewhat toward the throat, sometimes vertically compressed, thus closing the throat, entirely glabrous within or variously pilose-annulate or pubescent, the upper lip ascending, plane, by no means galeate, usually incised and the segments somewhat divaricate, sometimes retuse, less often entire, almost suppressed in one species, the lower lip usually declined, the laterals more or less spreading, the middle either entire or laciniate or erose, sometimes strongly cupped, sometimes plane, sometimes strongly convex or all, depending upon the degree of anthesis; stamens seated in the throat, even toward the middle of the tube, or upon the base of the lower lip, sometimes ascending under the upper lip, sometimes thrust out from the tube or even declined along the lower lip; filament very short, almost wanting in one species, or about equal to the connective, articulated with it, the lower portion and one anther being completely suppressed; style glabrous, its branches either subequal or the posterior shorter; nutlets gelatinous when wetted.[1]

[1] Jepson (Manual) has sought to differentiate between Echinosphace and Pycnosphace, on the one hand, and the remaining species, on the other, by the presence or absence of the gelatinous coat. If mature nutlets are used, all species will be found to afford it in some degree, although *S. funerea* and *S. spathacea* do so but little.

KEY TO THE SUBSECTIONS

Both branches of the connective manifest, bearing perfect anthers; leaves pinnatifid or sinuate-spinose and iliciform (frequently entire in *S. funerea* but spinose at the tip).

Calyx teeth free; long arm of the connective ascending from the base of the lower lip, the shorter projected into the tube, or sometimes (*S. funerea*) both more or less contained within the tube; arachnoid herbs or spinose shrubs .... Echinosphace

Posterior calyx teeth joined into a gibbous lip; long arm of the connective ascending under the upper lip, the lower deflexed; annual hispidulous herbs .... Pycnosphace

Lower arm of the connective usually wholly suppressed, rarely (*S. spathacea*) manifest, and even bearing a minute anther; leaves crenulate or entire.

Stamens ascending under the upper lip and but little surpassing it or not at all, even entirely concealed within the tube (*S. Brandegei*).

Stout perennial viscid herbs with hastate or deltoid-oblong leaves 8–20 cm. long; corolla-tubes 25–35 mm. long.................. Greeneostachys

Shrubs with oblong-elliptical, obovate or even linear leaves; corolla-tubes 5.5–9.5 mm. long....................................... Parishiella

Stamens thrust forth from the tube or even declined, patently longer than the upper lip... Jepsonia

Subsect. Echinosphace

Sect. *Echinosphace* Benth., Lab. Gen. et Sp. 302. 1833, based upon *S. carduacea.*

Singular annual herbs with arachnoid pubescence and basal pinnatifid leaves, or shrubs with small leaves usually spinose-toothed and iliciform, sometimes entire but spine-tipped, clothed with branching hairs, rarely glandular; flowers of the annual species borne in dense echinate heads concealed in cottony hairs, subtended by reflexed spinose bracts, of the perennial species disposed in the axils of the upper leaves, subtended by small bractlets; calyx teeth 5, deltoid, subequal and obtuse or acute, or unequal, the lateral pair partly adnate to the upper, all spinose; corolla-tubes of the annual species strongly pilose-annulate near the middle, those of the shrubs glabrous or sparsely pubescent, lobes of the upper lip partly free, the middle lobe laciniate, either concave or convex; stamens seated either in the throat or on the base of the lower lip, each bearing two perfect anthers of unequal size, the longer arm of the connective ascending from the base of the lower lip, the shorter thrust into the tube, or sometimes the longer anther contained

wholly within the tube, the filaments short or nearly wanting; style branches equal or nearly so.

A thistle-like annual herb with basal pinnatifid leaves spinosely dentate, arachnoid .... *1. S. carduacea*
Shrubs with leaves mostly iliciform, sometimes entire but spine-tipped.
Calyx teeth deltoid, acute or obtuse, subequal.
Corolla-tubes 5–7 mm. long; connectives 4–6 mm. long .... *2. S. californica*
Corolla-tubes 9–11 mm. long; connectives 1.5 mm. long .... *3. S. funerea*
Calyx teeth lanceolate-spinose; corolla-tubes 9–11 mm. long; connectives 2.5 mm. long .... *4. S. Greatae*

DOUGLASIANA

Singular arachnoid annual herbs with pinnatifid leaves; flowers in compact echinate glomerules, the calyces hidden in cottony wool, subtended by spinose reflexed bracts, disposed in stout moniliform spikes; calyx teeth partly joined, spinose; corolla-tubes strongly pilose-annulate near the middle, the middle lobe of the lower lip large and showy, laciniate, convex.

1. S. carduacea Benth., Lab. Gen. et Sp. 302. 1833, based upon a specimen collected by Douglas in California; the type is in the herbarium of the Royal Botanic Gardens at Kew.

Plate 12.

S. gossypina Benth., Pl. Hartweg. 330. 1839, based upon a specimen collected by Hartweg in the Sacramento Valley; the type is in the herbarium of the Royal Botanic Gardens at Kew.

A striking and handsome herb suggesting *Carduus,* arachnoid-woolly throughout, 10–15 cm. tall in forms dwarfed by aridity, as much as a meter tall when luxuriant, its flowering stems one or more; leaves entirely basal, mostly 8–15 cm. long, oblong-elliptical in outline, subsessile, pinnatifid, their lobes deltoid, spinose-toothed, crisped; flowers numerous in globose glomerules subtended by several oblong-iliciform reflexed bracts, solitary or several, disposed at the tips of the usually strict sometimes ternate stems, remote; flowering calyces prevailingly 15–17 mm. long, white with very long soft-cottony hairs in the mat of which they lie buried, teeth of the lower lip about 5 mm. long, the upper three joined to the middle, twice as long, all spinose; corolla a lovely violet, mostly 15–17 mm. long,

strongly and obliquely pilose-annulate near the middle, the lobes of the upper lip subequal to the tube, narrowed near the middle, erose at the tips, the middle lobe of the lower subequal,

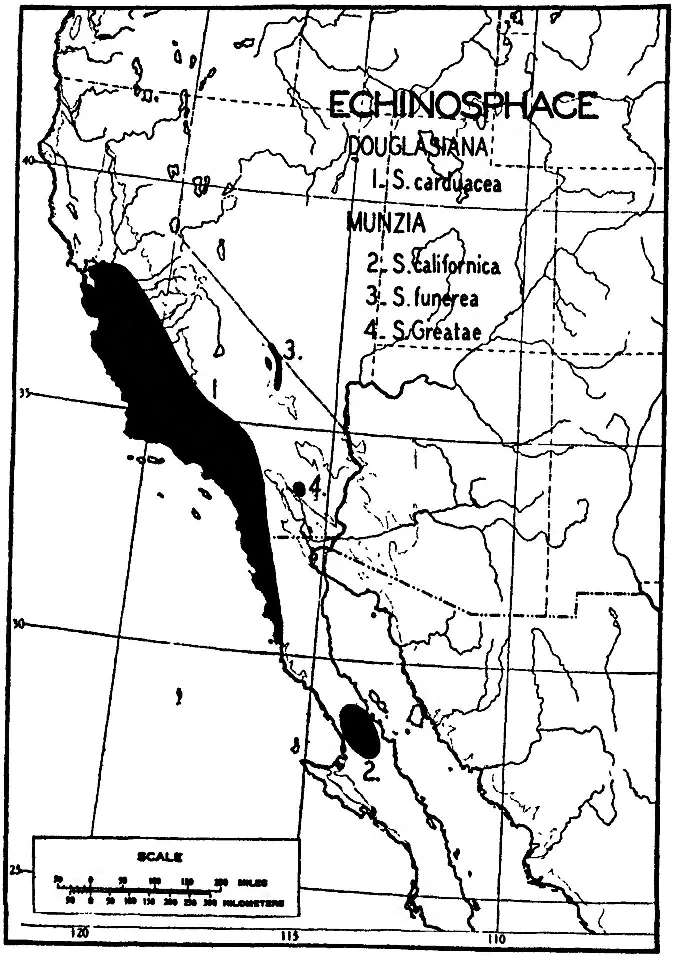


Fig. 1. Showing distribution of *S. carduacea*, *S. californica*, *S. funerea*, and *S. Greatae*.

broadly spreading, laciniate, the laciniae white at the tips; stamens seated on the base of the lower lip, the filament practically wanting, the connectives 12–14 mm. long; style branches subequal.

The species ranges from interior Contra Costa, San Joaquin, and Stanislaus counties southeastward through the Great Valley and interior valleys of the coast ranges to Kern County and thence through the western Mojave Desert from Inyokern and Searles Station southward along the western margin of the Colorado Desert to northern Lower California, as far south, at least, as San Quintin and as far east as Barstow. Throughout this range it is associated with a variety of plants and is found usually in sandy, often disturbed soil. Its occurrence is chiefly in two formations: the coastal sage formation *(Artemisia californica-Salvia* spp.*-Eriogonum fasciculatum)* and the Sonoran formation *(Larrea mexicana-Franseria dumosa-Yucca brevifolia).* While it is most frequently seen in the former, it seems usually to occupy disturbed ground there, as though an interloper, although I have observed it as far south as San Quintin in the *Artemisia* association growing under natural conditions. It appears to be natural to the western part of the Mojave Desert *(Larrea-Franseria),* occurring there chiefly in sandy or gravelly soil of the valleys and in a good year frequent and abundant. It enters only into the western margin of the Colorado Desert, however. At the same time is occurs widely and sometimes in great abundance on the alluvial cones of the Great Valley. It seldom ranges above 4,000 feet. The corolla is exquisite in form and coloring, the tips of the fringe being white, the anthers lacquer-red. The odor of the foliage is pungent, suggestive of *Citronella* in which respect it is like *S. Greatae.* It belongs to that class of plants sometimes known as "winter annuals," flowering after the winter rains mostly in April, May, and June, and soon disappearing. Following are localities where the species has been found:

CALIFORNIA: CONTRA COSTA: Antioch; ALAMEDA: Corral Hollow; SAN JOAQUIN: Tracy, Calaveras R.; STANISLAUS: Knight's Ferry, Adobe Valley, Crows Landing; MADERA: Berenda; FRESNO: Coalinga; TULARE: Porterville, Visalia, Grapevine Spring, Delano, Earlimart; SAN BENITO: Panoche, San Benito; MONTEREY: Arroyo Seco, Palomar Cr., Lockwood; SAN LUIS OBISPO: Cholame, Nipomo, Pala Prieta of Bitterwater Valley; KERN: Rosamond, Bakersfield, Wasco, Lebec, Caliente, Pama Sta., Jewette, Searles, Mojave; SANTA BARBARA: Orcutt, Betteravia; LOS ANGELES: Peace Valley, Tejon Rancho, Gorman's, Lancaster, Palmdale, Pomona, Acton, Claremont; SAN BERNARDINO: Helendale, Barstow, Crofton, Hesperia;

ORANGE: Orange, Vale Verde near Galivan; RIVERSIDE: Banning, Riverside, Temecula, Colton, Winchester, Perris, Elsinore, San Jacinto Valley; SAN DIEGO: San Diego, San Felipe, Jacumba, Mason Valley; BAJA CALIFORNIA: San Quintin.

MUNZIA

Singular rounded herbs with leaves usually iliciform, sessile, sometimes entire but spine-tipped; flowers few in the axils of the upper leaves, subtended by small bractlets; calyx teeth either deltoid and subequal, obtuse or acute, or else unequal and spinose; corolla-tubes either glabrous within or sparsely pilose, not at all annulate, the middle lobe erose or laciniate, concave or plane; filaments short, both anthers perfect, the lower usually smaller (larger and included within the tube of *S. funerea).*

The habit of these shrubs is very similar to the species of *Atriplex* with which they are commonly associated. All three occur in areas where volcanic rock is present, although not usually on such rock but upon sedimentary rock associated with it. *S. funerea* and *S. Greatae* occur in gravelly washes of narrow canyons or on the sides of the canyons above such washes from about 1000 feet to 3000 feet. *S. californica* occurs in open broad gravelly washes. All are found in the *Larrea-Franseria* formation and are associated with species of *Atriplex* and *Encelia,* and two, *S. californica* and *S. Greatae,* occur in company with *Hyptis Emoryi.*

2. **S. californica** Brandegee in Proc. Calif. Acad., II, 2: 197. 1889, based upon a specimen collected by Brandegee in Baja California at "Cardon Grande" near Calmalli; the type is in the herbarium of the University of California (Berkeley).

Plate 13.

A shrub 1–2.5 m. tall, its branchlets whitened with floccose branching hairs and sprinkled with golden glands; leaf-blades .5–4 cm. long, sessile, crowded, oblong-iliciform, the teeth usually 6–9, deltoid, shortly spinose, both surfaces floccose and whitened with branched hairs; flowers 3–6 in the axils of diminished iliciform leaves, the glomerules .5–3 cm. distant; flowering calyces 4.5 mm. long, whitened with floccose branching hairs, their teeth deltoid, subequal, the three posterior

somewhat united; corolla-tubes (? white or pallid) 5–7 mm. long, the upper lip 2 mm. tall, the lower twice as long, very sparsely pilose above, the middle lobe nearly plane; stamens adnate to the base of the lower lip, the filament scarcely 1 mm. long, the connective 4–6 mm. long; style branches equal.

Found in Baja California in sandy gravelly washes with species of *Atriplex, Hyptis Emoryi, Hymenoclea Salsola, Viguiera reticulata,* and *Encelia farinosa.* It is known to occur at San Pablo, Cardon Grande near Calmalli, Lagoon Head (? Scamman's Lagoon), 10 mi. w. of Calmalli, San Gertrudis, 18 mi. w. of Punta Prieta, and Los Angeles Bay. It is known locally at Calmalli and San Gertrudis as "Salvia China." I was unable to learn the significance of the term.

3. **S. funerea** Jones, Contrib. West. Bot. 12: 71. 1908, based upon a specimen collected in Inyo Co., Calif., in the Funeral (Amargosa) Range; the type is in the herbarium of Pomona College. Plate 14.

S. funerea var. *fornacis* Jeps., Man. Calif. 868. 1925, based upon a collection made by Parish (no. 10032) in Furnace Creek, Death Valley; the type is in Jepson's herbarium.

A white shrub as much as a meter and a half tall, its branchlets densely lanate with branched hairs; leaf-blades 1.5–2 cm. long, elliptical or ovate, acuminate-spinose at the apex, frequently rounded below the middle, more commonly narrowed to petioles 2–5 mm. long, mostly entire, some usually iliciform with one or two pairs of stout spinose teeth, both surfaces ashy or white with branching hairs; flowers prevailingly 3 in the axils of usually iliciform leaves, crowded into foliose spikes 3–8 cm. long; flowering calyces very densely white-lanate with branching hairs, 4.5–6 mm. long, their teeth subequal, deltoid, the three posterior lightly joined at the base; corolla violet, its tube 9–11 mm. long, pilose within above the middle and in the palate, the upper lip 2–2.5 mm. tall, the lower twice as long; stamens seated between the middle of the tube and the throat; filaments 1.5–2.5 mm. long, the connective 1.5 mm. long; style branches equal and somewhat dilated.

General throughout narrow canyons on the western slopes

of the Amargosa Range (Granite, Funeral, and Black Mountains), ranging at least from Hole-in-the-Rock Spring to Furnace Creek, Travertine Canyon, and Ryan. It occurs in the Grapevine Mountains in Titus Canyon and in the northern part of the Panamint Mountains in Grotto and Mosaic Canyons and possibly further south. It is found from about 1000 to about 3000 feet, in the narrow canyons, both in the washes and in small gullies entering them or on narrow benches above the washes. It is an associate of the *Larrea-Franseria* formation and is most often found with *Atriplex hymenelytra, Viguiera reticulata, Encelia farinosa* or *E. Actoni,* and *Eucnide urens.*

4. **S. Greatae** Brandegee in Zoe **5**: 229. 1906, based upon a specimen collected in Riverside Co., Calif., in Canyon Springs Wash near Dos Palmas by Hall and Greata (no. 5848); the type is in the herbarium of the University of California (Berkeley).
Plate 15.

A fragrant shrub rounded and dense, as much as a meter tall, its branchlets whitened with branching hairs, less often glandular with small spreading hairs and sprinkled with longer spreading stout ones; leaf-blades generally 2–3 cm. long, sessile, iliciform or the lowest nearly entire and elliptical, prevailingly ashy with branched hairs, sometimes more or less glandular, especially the lower becoming glabrate; flowers numerous in the axils of iliciform leaves, the glomerules mostly 3–6 cm. distant; flowering calyces 11–12 mm. long, generally incanous with branching hairs, sometimes entirely glandular, arcuate-gibbous, the lower lip 3–3.5 mm. long, the three upper teeth partly united, the posterior one twice as long as the lateral ones, all spinose; corolla rose, its tube 9–11 mm. long, the upper lip 2–2.5 mm. tall, the lower almost twice as long, very sparingly pilose on the upper surface, the middle lobe lightly cupped; stamens seated nearly in the throat, the filament 1 mm. long, the connective 2.5 mm. long; style branches equal.

This species is known only from the Orocopia Mountains where it occurs in a canyon near Dos Palmas (east of Mecca, California), Salt Creek Wash, and in the narrow canyons behind Hidden Spring, ranging from about 500 feet elevation. In the canyon bottom it occurs in loose gravel and rocks in the

Larrea-Franseria formation with *Hyptis Emoryi, Bebbia juncea, Cercidium Torreyanum, Peucephyllum Schottii, Acacia Greggii,* and *Encelia farinosa;* on the sides of the canyon above the wash its principal associate is *Encelia farinosa.* Like *S. Vaseyi* the corolla-tube is vertically compressed in the throat. It is not improbable that the species will be found in other canyons in the Orocopia Mountains.

Subsect. PYCNOSPHACE

Pycnosphace Benth., Lab. Gen. et Sp. 302. 1833, as section, based upon *S. Columbariae;* Rydb., Fl. Rocky Mts. 747. 1917, as genus.

Singular annual herbs with pinnatifid hispidulous leaves; flowers many in compact usually capitate sometimes remotely moniliform glomerules, subtended by spine-tipped rotund bracts; upper calyx teeth completely joined, provided with two or sometimes three spines at the tip, the lower free, spinose; corolla-tube glabrous; stamens seated toward the throat, the long arm of the connective ascending under the upper lip, somewhat surpassing it, the shorter deflexed, both anthers perfect, the lower smaller.

One species...5. *S. Columbariae*

5. S. Columbariae Benth., Lab. Gen. et Sp. 302. 1833, based upon a specimen collected in California by Douglas; the type is in the herbarium of the Royal Botanic Gardens at Kew.

Plate 16.

Pycnosphace Columbariae Rydb., Fl. Rocky Mts. 747. 1917.

A singular annual herb 3–4 cm. tall in drouth forms, or 30–50 cm. tall in robust forms, their flowering stems one or more, mostly retrorse-hispidulous, frequently sprinkled with longer thick hairs; leaves mostly basal, with usually one or two cauline pairs, pinnatifid, oblong-ovate in outline, their lobes crenate or again rounded-lobed, both surfaces more or less hispidulous, the upper bullulate, the lowermost borne on subequal petioles, the upper sessile or nearly so; flowers many in glomerules either solitary or sometimes 2–3, these subtended by

overlapping rotund colored bracts, glabrous or hispidulous, ciliate, notched, provided with a spine in the notch; flowering calyces mostly 8–10 mm. long, hispidulous, more or less glandular, arcuate-gibbous, bearded on the hump with long thickened

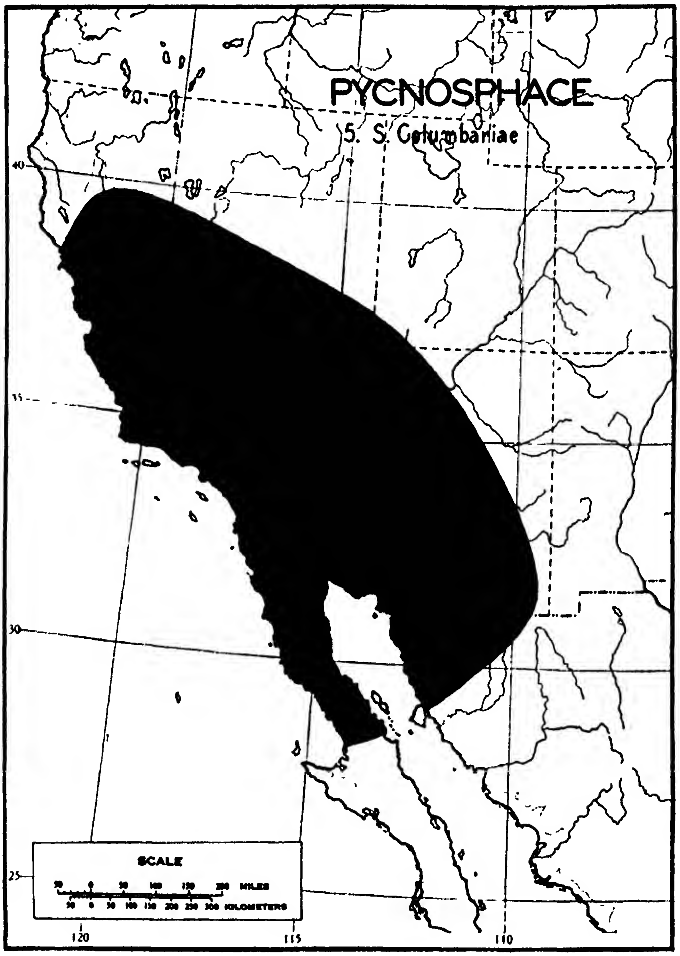


Fig. 2. Showing distribution of *S. Columbariae.*

hairs, the teeth of the lower lip 2.5–3 mm. long, all spinose, the teeth of the upper lip wholly joined save for the spines, the middle one of which is usually suppressed; corolla clear blue, its tube mostly 7–8 mm. long, glabrous within, the upper lip

2.5–3 mm. tall, the lower about twice as long, entire; stamens seated in the throat, the filament about 1.5 mm. long, the connective about 2.5 mm. long; posterior style branch mostly half as long as the anterior, or less.

An ubiquitous vernal plant in southern California, most variable in stature, occupying dry, often disturbed soil, in association with the chaparral, the coastal sage, the Great Basin microphyll or Sonoran Desert formations. Found usually below 4000 feet, but may occur at least as high as 7000 feet. Ranges from Glenn and Butte counties southward through the coast ranges into Baja California as far south as Cedros Island, southeastward from Tuolumne and Stanislaus counties throughout southern California, through Nevada (Washoe, Mineral, Nye, Lincoln and Clark counties) to Washington County, Utah, through western and southern Arizona (Mohave, Maricopa, Pima, Gila, and Cochise counties) into northern Sonora. It is known to occur on Santa Catalina and San Clemente Islands and perhaps upon the other coastal islands as well. Throughout this range the species is remarkably constant, save for variability in stature due to water supply during growth.

Subsect. Greeneostachys

Stout viscid perennial herbs with creeping rootstocks, the flowering stems ascending; leaves ample, deltoid-oblong or hastate, borne on marginate or winged petioles; flowers many in large viscid glomerules disposed in stout moniliform spikes, subtended by colored appressed bracts; upper calyx teeth wholly joined to a gibbous lip, the two lower small, free; corolla-tube glabrous; stamens ascending under the upper lip and exceeding it, the lower part of the connective half as long as the upper or less, the lower anther usually suppressed, rarely vestigial.

One species...6. *S. spathacea*

6. S. spathacea Greene in Pittonia 2: 236. 1892, based upon *Audibertia grandiflora* Benth., loc. cit. (not *S. grandiflora* Etling). Plate 17.

Audibertia decurrens Nutt. ex Benth. in DC. Prodr. **12**: 359. 1848 (an herbarium name cited in synonomy).

Audibertia grandiflora Benth., Lab. Gen. et Sp. 312. 1833, based upon a specimen collected in California by Douglas; the type is in the herbarium of the Royal Botanic Gardens at Kew.

Audibertiella grandiflora Briq. in Bull. Herb. Boiss. **2**: 73. 1894, based upon *Audibertia grandiflora* Benth., loc. cit.

Ramona grandiflora Briq., loc. cit., 440. 1894, based upon *Audibertia grandiflora* Benth., loc. cit.

A perennial herb with creeping rhizomes, frequently forming mat-like clumps, its annual stem usually solitary, stout, ascending usually 0.5–1 m., viscid-pilose throughout with spreading hairs; leaves approximate toward the base, the blades prevailingly oblong-hastate, 8–20 cm. long, obtuse, truncate-subhastate at the base, irregularly crenate, rarely somewhat lobed, the upper surfaces bullulate, sparingly viscid-pilose, the lower ashy-tomentose or glabrate, borne on petioles mostly 3–8 cm. long, these margined or winged and clasping at the base; flowers numerous in glomerules 3–6 cm. distant, disposed in coarse viscid interrupted spikes 20–30 cm. long or more, subtended by numerous ovate or elliptical viscid appressed acuminate bracts, usually purplish; flowering calyces 22–30 mm. long, viscid-pilose, hispidulous within, the teeth of the lower lip 2–4 mm. long, weakly spinose, cut between them to a depth of 8–12 mm., the teeth of the upper lip wholly connate, rarely trimucronate at the tip; corolla crimson, its tube glabrous within, 25–35 mm. long, narrowed below the middle, the upper lip 7–8 mm. tall, the lower somewhat longer; stamens seated between the middle of the tube and the throat, ascending under the upper lip, their filaments equal to the tube, the connective 10–15 mm. long, the lower anther sometimes somewhat polliniferous; posterior style branch shorter, of varying length.

Ranges from Solano County near Vacaville southward in the coastal counties to Orange County, although apparently never collected in Alameda County. It is infrequent although

locally abundant, associated chiefly with the valley woodland formation *(Quercus agrifolia, Q. Douglasii, Q. lobata, Q. Wislizeni),* occurring on open slopes though usually in partial shade of other species, especially *Quercus agrifolia.* It may

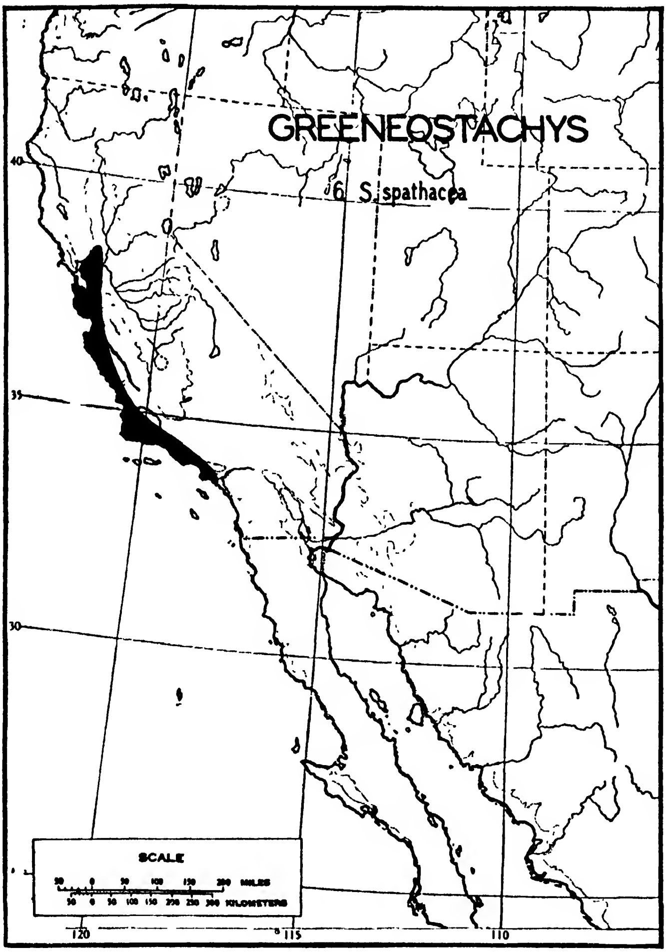


Fig. 3. Showing distribution of *S. spathacea.*

grow near *Salvia mcllifera, apiana, leucophylla,* and *Columbariae,* but I have never seen it growing actually with any of these species, nor have I seen any suggestion of a hybrid form. Following are localities where it is known to occur:

California: solano: Vacaville; contra costa: Pine Canyon, foot of Mt. Diablo; san mateo: San Bruno Hills, Colma; monterey: Tassajara Hot Springs, Morro Cr., Santa Lucia Mts.; san luis obispo: Paso Robles, Atascadero, Cambria, San Luis, Morro; santa barbara: Surf, Santa Maria, Mission Canyon near Santa Barbara, Cuyama Canyon, Montecito, San Isidro Ranch, Zaca Lake Forest Reserve, Carpenteria, Gaviota Pass; ventura: Foster Park, Ojai Cr.; los angeles: Los Alisos, Los Flores, Mandeville and Topanga Canyons of Santa Monica Mts., Pasadena, Calabasas, Pacific Palisades, Mint Canyon, Mulholland Highway in Bel Air; orange: Laguna, Santa Ana Canyon (Aliso Canyon).

Subsect. Parishiella

Shrubs with bullate-rugose leaves, oblong-elliptical or obovate, even linear, the upper surfaces glabrous or hirtellous, green, the lower ashy or whitened with appressed hairs, one species with branched hairs; flowers numerous in compact glomerules subtended by appressed often weakly spinose bracts, disposed in moniliform spikes, often branched; upper calyx teeth wholly united, usually trimucronate, the lower free, shortly spinose; corolla-tubes either narrowly pilose-annulate within near the middle or pubescent above the middle; the stamens seated in the throat, the filaments scarcely if at all exserted from the tube, the anthers ascending under the upper lip, but little or not at all exceeding it, entirely concealed within the tube of *S. Brandegei;* posterior style branch shorter.

Leaves linear, revolute, whitened below with branched hairs; stamens wholly included in the tube .... *9. S. Brandegei*

Leaves oblong-elliptical or obovate, appressed pubescent beneath; stamens exserted from the tube.

Connectives somewhat exserted from the tube, the anthers somewhat exceeding the upper lip; leaves oblong-elliptical, prevailingly 3–6 cm. long .... *7. S. mellifera*

Connectives included within the tube, the anthers shorter than the upper lip; leaf-blades prevailingly 12–15 mm. long, rarely as much as 4 cm., mostly obovate or oblanceolate .... *8. S. Munzii*

7. S. mellifera Greene in Pittonia 2: 236. 1892, based upon *Audibertia stachyoides* Benth., loc. cit. (not *S. stachyoides* Kunth). Plate 18.

Audibertia stachyoides Benth., Lab. Gen. et Sp. 313. 1833, based upon a specimen collected in California by Douglas; the type is in the herbarium of the Royal Botanic Gardens at Kew.

S. mellifera var. *typica* Munz in Bull. S. Calif. Acad. Sci. **26**: 24. 1927, based upon the same.

Audibertia spinulosa Nutt. ex Benth. in DC., Prodr. **12**: 359. 1848 (an herbarium name cited in synonomy).

Audibertiella stachyoides Briq. in Bull. Herb. Boiss. **2**: 73. 1894, based upon the preceding.

Ramona stachyoides Briq., loc. cit., 440. 1894, based upon the same.

A shrub 1–2 m. tall, its branchlets pubescent with usually retrorse hairs, sometimes villous, more or less glandular; leaf-blades prevailingly 3–6 cm. long, oblong-elliptical, obtuse at the apex, narrowed below the middle to more or less margined petioles 3–12 mm. long, the upper surfaces bullate, green, glabrate or hirtellous, the lower ashy, less often whitened by appressed hairs, areolate, the margins crenulate, flowers many in compact glomerules prevailingly 2–4 cm. in diameter including the flowers, subtended by ovate bracts, reflexed at maturity, hirtellous or villous, more or less glandular, either acuminate or shortly spinose, disposed in moniliform spikes, usually panicled, mostly 2–6 cm. distant; flowering calyces 5.5–7 mm. long, villous and more or less glandular, hispidulous within, the lower teeth free, 1.5–2 mm. long, ovate, acuminate-spinose, those of the upper lip joined to the apex, muticate or (usually) trimucronate, rarely shortly tridentate; corolla pale blue or tinged with rose, or whitish, its tube 5.5–9 mm. long, mostly about 9 mm., narrowly and transversely annulate near the middle, the upper lip 2.5–3 mm. tall, retuse, the lower twice as long, its middle lip cupped; stamens ascending under the upper lip, seated within the throat, exserted from the corolla-tube 3–4 mm., the connective and filament subequal.

This species is one of the principal shrubs of the coastal sage formation *(Artemisia californica, S. mellifera, S. apiana, S. leucophylla, Rhus laurina, Rhus integrifolia),* ranging from the Bay region to a point somewhat south of Tijuana. Southward from San Diego County its place in the formation is assumed by *S. Munzii.* As far as I know, the two species do not grow together, but both occur frequently with *S. apiana. S. mellifera*

occurs also with *S. leucophylla, S. Columbariae* and, infrequently, *S. Clevelandii* and *S. carduacea.* Hybrids are common with *S. apiana* and *S. leucophylla,* occasional with *S. Co-*

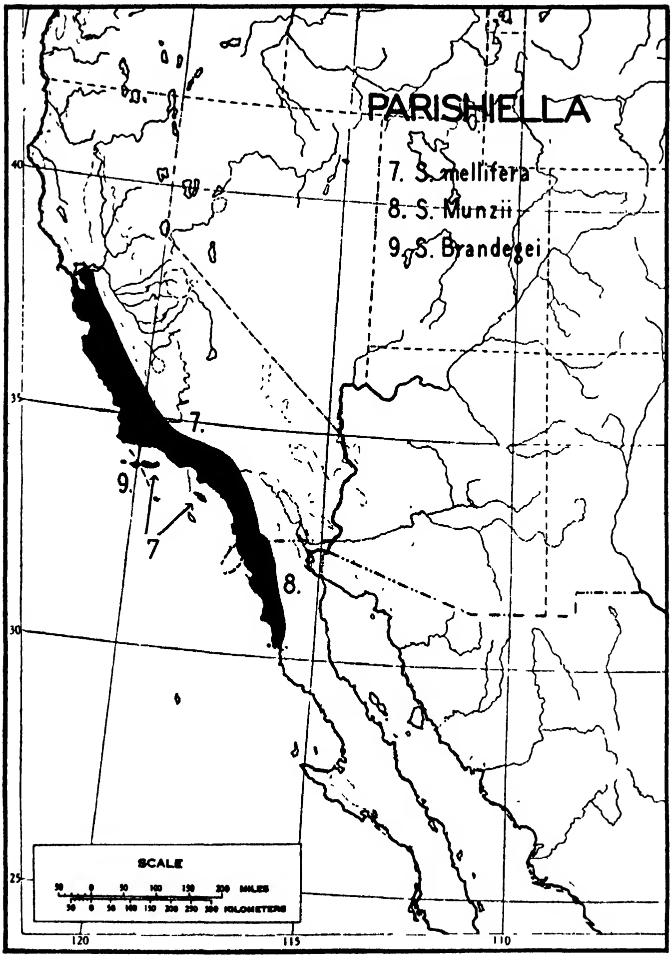


Fig. 4. Showing distribution of *S. mellifera, S. Munzii,* and *S. Brandegei.*

lumbariae and not recorded for *S. carduacea* or *S. Clevelandii.* The inflorescence of the coastal forms tends to be more branched and elongate than those of the interior, the flowers bluer, and the plant less compact. The last flowers of the sea-

son may simulate the flowers of *Salvia Munzii* in the reduced and included stamens.

The species ranges more or less continuously from Contra Costa, Alameda, western Stanislaus, and Santa Clara counties southward along the coast, extending into the interior coastal valleys, but apparently not into the Great Valley, to southern California. Here it is one of the most abundant species of the coast ranges and the lower parts of the Sierra, extending inland as far as Cajon Pass and the San Jacinto Mountains and southward through San Diego County west of the divide, into northern Lower California where it is soon replaced by *S. Munzii.* It occurs also on Santa Cruz and Catalina Islands. During the severe winter of 1936-37 occasional plants in the Santa Monica Mountains were frozen back. The species regenerates after fire chiefly by seedlings. It reaches its greatest development on low foothills, as in the Santa Monica Mountains. As the name suggests, it is an important bee plant.

8. **S. Munzii** Epl. in Madroño **3**: 169. 1935, based upon a specimen collected by Epling and Robison in a small arroyo south of the Hamilton Ranch, Lower California; the type is in the herbarium of the University of California (Los Angeles). Plate 19.

S. mellifera var. *Jonesii* Munz in Bull. S. Calif. Acad. Sci. **26**: 24. 1927, based upon a specimen collected in Lower California near Ensenada, by Jones (10. IV. 1882); the type is in the herbarium of Pomona College.

A rounded handsome shrub as much as 2.5 m. tall with branchlets appressed-hispidulous; leaf-blades primarily obovate-oblong, prevailingly 12–40 mm. long, rounded at the apex, narrowed below the middle to petioles 1–3 mm. long, frequently sessile, the upper surface bullulate, hirtellous, the lower clothed with minute appressed hairs, both ashy, their margins crenulate; flowers few in glomerules 10–15 mm. in diameter, subtended by usually oblong-elliptical appressed bracts about equal to the calyces, acute or shortly aristate, ciliolate and for the rest nearly glabrous, disposed in slender unbranched or sometimes ternate moniliform spikes; flowering calyces 4.5–6

mm. long, hirtellous, more or less glandular, the lower teeth free, 1.5–2 cm. long, subaristate, the upper completely joined and usually obscurely trimucronate; corolla clear blue, its tube 7–9.5 mm. long, puberulent within above the middle but hardly annulate, the upper lip 2–2.5 mm. tall, retuse, the lower twice as long; stamens seated about midway between the middle of the tube and the throat, shorter than the upper lip, the connective and filament subequal.

Ranges from San Miguel Mountain in San Diego County, at least as far south as Rosario, Baja California, and about 25 miles inland from that point, apparently falling within the range of *Rhus laurina.* It ranges from sea-level to perhaps 4000 feet, entering the *Idria* belt in Lower California. North of Ensenada, at least along the coast, it is spasmodic in occurrence. Southward it becomes more abundant, and in the vicinity of San Antonio Canyon is, with *Artemisia californica,* a co-dominant of the coastal sage formation. Its most constant associate throughout its range is *Artemisia californica.* In odor it more nearly resembles *S. Clevelandii* which it also resembles in foliage. It may be readily distinguished from *S. mellifera* by its more compact rounded habit, the usually unbranched inflorescence, the more obovate leaves, and particularly by the conformation of the corolla and stamens which are sometimes scarcely exserted from the corolla-tube. Its corollas are uniformly a darker blue than those of *S. mellifera,* rarely approaching it in color. Its flowering period is notably earlier than that of *S. mellifera,* it being in full flower throughout its range in the first part of February, 1935. While *S. mellifera* ranges south of Tijuana, I have not yet found the two growing together. I believe that *S. Munzii* in the northern part of its range occurs at higher elevations than *S. mellifera.* The species occurs near or perhaps with *S. Clevelandii* on San Antonio Mesa, Baja California, but no hybrids have thus far been observed. It occurs frequently with *S. apiana.*

Following are specific localities where the species is known to occur:

California: SAN DIEGO: San Miguel Mt., 2½ mi. s. e. of Sunnyside.

Baja California: 18 mi. n. of Ensenada, Salitre near Johnson Ranch, San An-

tonio Mesa and Canyon, La Grulla Gun Club, Arroyo Seco between San Rafael and San Antonio Mesa, San Telmo Abajo, San Rafael Valley, Rosario, 25 mi. e. of Rosario, Hamilton Ranch, Santa Clara Canyon, San Quintin, San Vicente Canyon, Ensenada, Las Salinas (? near S. Quintin), Cariso Cr., Las Animas Canyon between Ensenada and Santo Tomas.

9. S. Brandegei Munz in Bull. S. Calif. Acad Sci. **31:** 69. 1932, based upon *Audibertia stachyoides* var. *revoluta* Brandegee, loc. cit. Plate 20.

Audibertia stachyoides var. *revoluta* Brandegee in Proc. Calif. Acad. II, **1:** 216. 1888, based upon a specimen collected on Santa Rosa Island, Calif., by Brandegee; the type is in the herbarium of the University of California (Berkeley).

S. mellifera var. *revoluta* Munz in Bull. S. Calif. Acad. Sci. **26:** 23. 1927, based upon the same.

A shrub 1 m. tall or more, its branchlets pubescent with branching hairs; leaf-blades linear, prevailingly 2–4 cm. long, 2–5 mm. wide, obtuse, subsessile, their margins crenulate, revolute, the upper surfaces bullate, glabrous, green, the lower white-tomentose with branched and simple hairs; flowers few in glomerules 1.5–2 cm. in diameter, disposed in moniliform spikes, 1–3 cm. distant, subtended by ovate bracts shorter than the calyces, villous with branching hairs; flowering calyces 7–8 mm. long, villous with branching hairs, the teeth of the lower lip free, 1.5 mm. long, shortly spinose, the three posterior wholly joined except for the apex where trimucronate, 3.5–4 mm. tall; corolla lavender, almost rose-color, its tube 7–8 mm. long, pubescent within above the middle, hardly annulate, the lobes of the upper lip 3–3.5 mm. tall, joined almost to the apex, the middle lobe of the lower lip 3–4 mm. long, obcordate; stamens singular, the connective and filament together subequal to the anther, seated between the middle of the tube and the throat and wholly included within the tube; style shortly exserted.

This species occurs only on Santa Rosa Island, apparently playing the same rôle there in the coastal sage formation that *S. mellifera* and *S. Munzii* do on the mainland. While its principal associates there are *Artemisia californica* and *Rhus in-*

tegrifolia, its normal range is difficult to determine because of the profound modification of the original vegetation of the island through grazing and its replacement by introduced grasses. At present *S. Brandegei* occurs on the walls of a few of the steeper canyons, apparently on both sides of the island, ranging from sea-level to approximately 800 feet, entering (with *Artemisia californica)* into the chaparral belt (quercetal-chamisal). While *Artemisia californica* occurs elsewhere in small patches, due to the protection of *Opuntia,* it is not apparently accompanied by the *Salvia.*

Subsect. Jepsonia

Shrubs of varied habit or *(S. sonomensis)* suffrutescent prostrate herbs, of interest to the botanist not only by reason of the morphology of leaf and flower but because of their part in plant economy; leaves varied, now deltoid now oblong-elliptical or obovate, rarely *(S. leucophylla)* clothed with branched hairs; posterior calyx teeth wholly joined unless trimucronate or even aristate at the apex, the two inferior free, mostly acute, rarely spinose, even aristate (those of *S. leucophylla* wholly joined to the upper lip, the orifice accordingly oblique and truncate); corolla-tube more commonly pilose-annulate near the middle, less often pubescent usually above the middle; stamens seated either in the tube near the throat or on the base of the lower lip, thrust out from the tube or even declined on the lower lip, the connective and filament subequal, the whole clearly much longer than the upper lip, the lower arm of the former wholly suppressed, the articulation oblique and inconspicuous; style usually declined, the posterior branch shorter.

Perennial suffrutescent prostrate herbs........................*16. S. sonomensis*
Erect shrubs.
  Hairs branched; calyx teeth wholly united, the orifice therefore entire, oblique ....*11. S. leucophylla*
  Hairs simple; lower calyx teeth free.
    Leaf-blades entire, obovate, oblanceolate or spatulate, similarly clothed on both sides with minute appressed hairs.
      Corolla-tubes pubescent above the middle, scarcely annulate, 5–10 mm. long; calyces 5–7 mm. long..........................*14. S. carnosa*

Corolla-tubes more or less pubescent above the middle, strongly pilose-annulate below, 15–22 mm. long; calyces 8–13 mm. long..*13. S. pachyphylla*

Leaf-blades crenulate, sometimes obovate, mostly deltoid-oblong or oblong-elliptical, similarly clothed on both surfaces with minute hairs in two species but these leaves not obovate.

Leaves similarly clothed on both surfaces with minute appressed hairs, very white, the upper surface not bullate-rugose.

Leaves truncate or abruptly cuneate at the base; corolla-tubes 11–14 mm. long..*17 S. Vaseyi*

Leaves narrowed at the base; corolla tubes 5–7 mm. long.....*18. S. apiana*

Leaves bullate-rugose on the upper surfaces, green, the lower surfaces hispidulous or ashy with appressed hairs.

Leaves narrowed below the middle, elliptical-oblong or obovate, the lower surfaces ashy with appressed hairs; lower lip of corolla shorter than the upper..........................*10. S. Clevelandii*

Leaves tending to be deltoid, the lower surfaces hispidulous, green; lower lip of corolla longer than the upper.

Middle lobe of the lower lip entire, about 3–4 mm. long..*12. S. mohavensis*

Middle lobe of the lower lip erose, furcate, about 5–6 mm. long..*15. S. eremostachya*

10. S. Clevelandii Greene in Pittonia **2**: 236, 1892, based upon *Audibertia Clevelandii* Gray, loc. cit. Plate 21.

Audibertia Clevelandii Gray in Proc. Am. Acad. **10**: 76. 1874, based upon a specimen collected near Potrero, San Diego Co., by Cleveland; the type is in the Gray Herbarium.

Audibertiella Clevelandii Briq. in Bull. Herb. Boiss. **2**: 73. 1894, based upon the same.

Ramona Clevelandii Briq., loc. cit., 440. 1894, based upon the same.

A fragrant pretty shrub as much as a meter tall, its branchlets pubescent with retrorse hairs, ashy; leaf-blades 1.5–2.5 cm. long, usually elliptical, frequently obovate, obtuse at the apex, narrowed at the base to petioles 3–6 mm. long, their margins crenulate, the upper surfaces bullulate, hirtellous, the lower ashy or, especially when young, whitened with minute appressed hairs, areolate with prominent veins; flowers many in compact glomerules which are solitary, or two or three in remotely interrupted spikes, these even branched, subtended by firm ovate bracts shorter than the calyces, glandular-hispidu-

lous or the outer hirtellous; flowering calyces 8–10 mm. long, glandular-hispidulous, the teeth of the lower lip free, 1–1.5 mm. long, shortly spinose, the upper wholly joined unless trimucronate at the apex, 3.5–4 mm. tall; corolla dark violet-blue, its

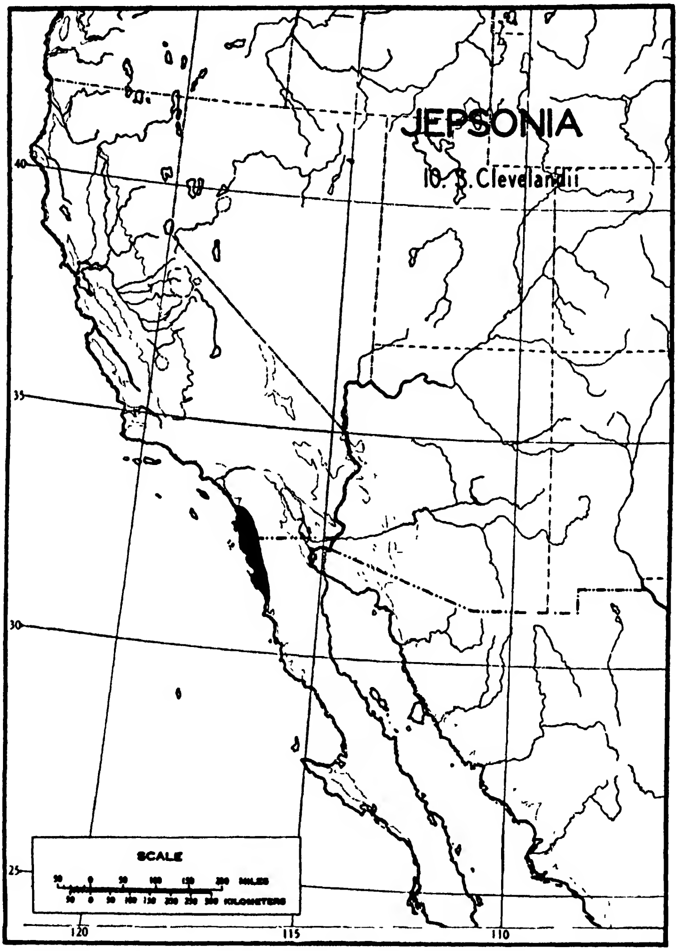


Fig. 5. Showing distribution of *S. Clevelandii.*

tube 12–18 mm. long, arcuate, transversely pilose-annulate below the middle, the lobes of the upper lip almost wholly united, 6–8 mm. tall, the middle lobe of the lower lip mostly oblong, 3–4 mm. long, plane, retuse, otherwise entire; stamens seated toward the throat, the connective and filament subequal.

This species is a component of the chaparral of western San Diego County, extending from the vicinity of Lake Henshaw southward to San Antonio Mesa, Baja California, from sea-level to about 3000 feet. It occurs most commonly with the chamise, *Adenostoma fasciculatum,* and *Ceanothus* spp., but frequently is found with species of the coastal sage formation: *Salvia mellifera, S. apiana, Rhamnus crocea, Cneoridium dumosum.* Hybrids are known with *S. apiana (S. Palmeri).* The foliage is fragrant with a sweetish sage-like odor, noticeable en masse in the open or when dry in the herbarium, persisting for long periods. Occasional albino heads occur.

Following are specific localities where the plant is known to grow:

CALIFORNIA: SAN DIEGO: Flinn Springs, Mt. Woodson, Otay Mt., Alpine, Palomar Mt., Henshaw Dam, between Ramona and Ballena, Tecate R., Del Mar, Moreno Grade, Japatul Valley, Torrey Pines Park, Descanso, Cottonwood Grade near Potrero, Palomar Mt., Laguna Mts., Valley Center, Soledad R., 2½ mi. south of Tenaja Guard Station on road to Santa Margarita.

BAJA CALIFORNIA: Tecate R., 30 mi. south of Tijuana, San Antonio Mesa at head of San Antonio Canyon. (This latter point marks the southern limit of the chamisal, as far as I have been able to observe.)

11. S. leucophylla Greene in Pittonia 2: 236. 1892, based upon *Audibertia nivea* Benth., loc. cit. (not *S. nivea* Thunb.).
Plate 22.

Audibertia nivea Benth., Lab. Gen. et Sp. 313. 1833, based upon a specimen collected by Douglas in California; the type is in the herbarium of the Royal Botanic Gardens at Kew.

Audibertiella nivea Briq. in Bull. Herb. Boiss. 2: 73. 1894, based upon the preceding.

Ramona nivea Briq., loc. cit., 440. 1894, based upon the same.

A handsome whitened shrub as much as 1.5 m. tall or more, its branchlets incanous with very minute branched hairs; leaf-blades deltoid-oblong, prevailingly 3–6 cm. long, rounded at the apex, usually truncate at the base, or narrowed in the smaller ones, borne on more or less margined petioles 3–8 mm. long, their margins crenulate, the upper surfaces bullulate, both surfaces, especially the lower, ashy or whitened with very

small branched hairs; flowers many in compact glomerules subtended by whitened ovate-elliptical appressed bracts equal to the calyces, arranged in stout moniliform spikes, 3–6 cm. distant; flowering calyces mostly 8–11 mm. long, whitened with

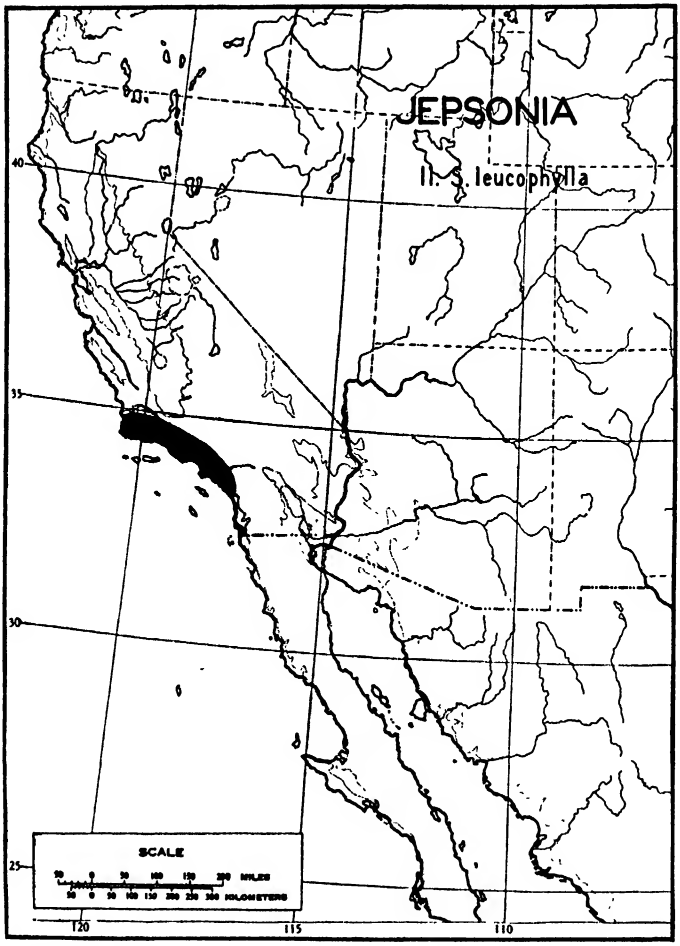


Fig. 6. Showing distribution of *S. leucophylla.*

minute branched hairs, the teeth wholly united into a single cucullate lip, the lower part sometimes barely evident, the orifice strongly oblique; corolla rose-color, rarely tending to bluish, its tube 10–13 mm. long, strongly pilose-annulate above the middle, the upper lip 6–8 mm. tall, oblong, its lobes free in the

upper part, the middle lobe of the lower lip oblong, plane, 4–5 mm. long; stamens seated in the throat, the connective shorter than the filament.

This species is a component of and an important member of the sage formation within its range. It occurs with *S. mellifera* and frequently with *S. apiana,* but often in pure and even dense stands, forming a close-cropped gray mantle of velvety texture over the rounded coastal hills. It is unique in the section by reason of the branched pubescence, the truncate calyx, and the conformation of the corolla. It is a noteworthy bee plant.

Following are localities where it is known to occur:

CALIFORNIA: SAN LUIS OBISPO: Pismo Beach, San Luis Obispo; SANTA BARBARA: Santa Inez Mts., between Zaca Lake and Los Olivos, Mission Ridge (Santa Barbara), Lompoc (Salsipuedes Canyon), Montecito, Cuyama Cañon; KERN: Lebec; VENTURA: Fillmore, Santa Paula, below Mutau Flat, Piru Cr., Sulfur Mt. near Ojai, Sespe Cr.; LOS ANGELES: Los Alisos Canyon near Santa Monica, Girard, Malibu Hills, Calabasas, Bouquet Canyon, San Francisquito Canyon, Pico Canyon near Newhall, Castaic, Topanga Canyon (intermixed with both *S. mellifera* and *S. apiana),* Pt. Dume, Puente Hills; SAN BERNARDINO: Chino Hills; ORANGE: Santa Ana Canyon, Black Star Canyon, Santiago Canyon.

12. S. mohavensis Greene in Pittonia **2**: 235. 1892, based upon *Audibertia capitata* Gray, loc. cit. (not *S. capitata* Schlecht.). Plate 23.

Audibertia capitata Gray in Proc. Am. Acad. **7**: 387. 1868, based upon a specimen collected in San Bernardino Co., Calif., in the Providence Mts., by Cooper; the type is in the Gray Herbarium.

Audibertiella capitata Briq. in Bull. Herb. Boiss. **2**: 73. 1894, based upon *Audibertia capitata* Gray, loc. cit.

Ramona capitata Briq., loc. cit. 440. 1894, based upon *Audibertia capitata* Gray, loc. cit.

A low rounded shrub as much as a meter or more tall, but commonly less, its branchlets hispidulous; leaf-blades prevailingly 1.5–2 cm. long, for the most part deltoid, sometimes narrowly so or oblong-elliptical, obtuse, truncate at the base or narrowed to petioles 5–8 mm. long, their margins crenulate, the upper surfaces bullulate, the lower reticulately veined, both more or less hispidulous and sprinkled with sessile glands; flowers few in a loose subglobose head, subtended by submem-

braneous bracts, the outer ovate, the inner linear, all usually whitish; flowering calyces 7–12 mm. long, hirtellous, ciliate, more or less glandular, the teeth of the lower lip nearly free, usually ovate, acuminate, 1–2 mm. long, those of the upper com-

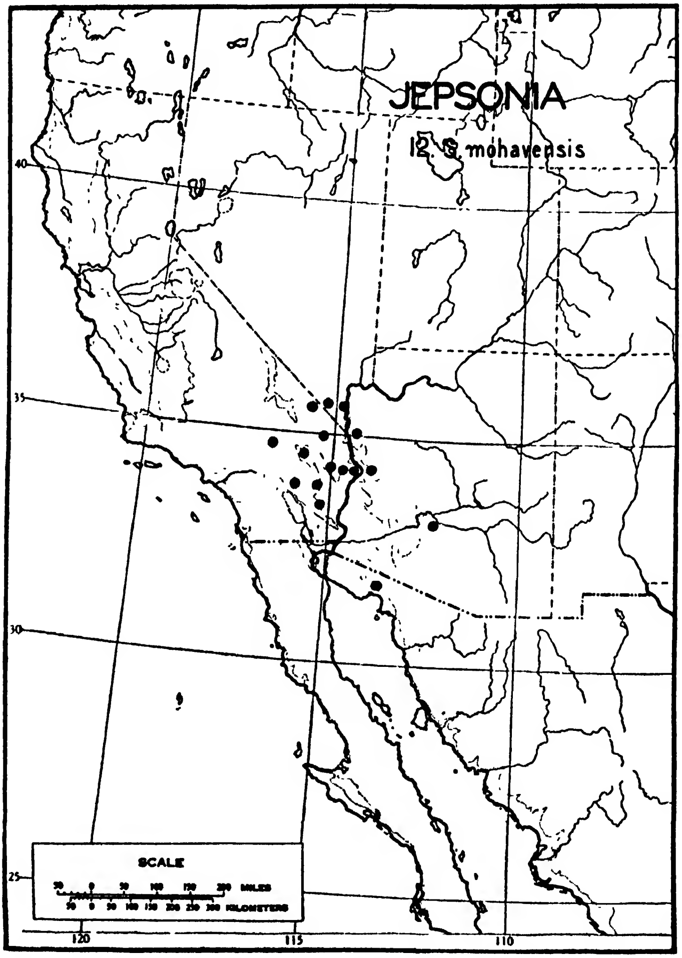


Fig. 7. Showing distribution of *S. mohavensis.*

pletely joined unless weakly trimucronate at the apex, 2.5–3.5 mm. tall; corolla pale blue or lavender, its tube slender, flaring near the throat, pubescent within above the middle, the lobes of the upper lip joined to the middle, 3.5 mm. tall, the

middle lobe of the lower subequal, nearly plane, entire; stamens seated in the throat, the connective somewhat shorter than the filament, the joint obvious; upper style branch shorter.

This species ranges from the Little San Bernardino Mountains near Lost Horse Well and Keyes Lookout through eastern San Bernardino and Riverside counties to Pinacate Mt., Sonora. In California it is known from the Little San Bernardino, Sheep Hole, Providence, Old Woman, Whipple, Old Dad, Eagle, Ord, Turtle, Clark, and Newberry Mountains. In Nevada it is known from Clark County: Good Springs, Meca Spring, and Eldorado Canyon near Nelson. In Arizona it is known from the Black Ute Mts. (Battleship Rock), the Chimehuevis Mts., and the Sierra Estrella. In Sonora it is known only from Pinacate Mt. It occurs in the upper part of the *Larrea-Franseria* formation, verging toward the piñon-juniper belt. It is found especially in rocky places and on steep rocky canyon walls.

13. **S. pachyphylla** Epl. ex Munz, Man. So. Calif. Bot. 445. 1935, based upon *Audibertia incana* var. *pachystachya* Gray, loc. cit. (not *S. pachystachya* Trautv.). Plate 24.

Audibertia incana var. *pachystachya* Gray, Syn. Fl. N. Am., ed. 2, **2**, pt. 1: 461. 1886, based upon a specimen collected in California in Bear Valley in the San Bernardino Mts., by the Parish brothers (no. 330); the type is in the Gray Herbarium.

Audibertia pachystachya Parish in Erythea **6**: 91. 1898, based upon the above.

Ramona pachystachya Heller in Muhlenbergia **1**: 4. 1900, based upon the same.

S. carnosa var. *compacta* Hall in Univ. Calif. Publ. Bot. **1**: 111. 1902, based upon *Audibertia incana* var. *pachystachya* Gray, loc. cit.

S. compacta Munz in Bull. S. Calif. Acad. Sci. **26**: 22. 1927, based upon *S. carnosa* var. *compacta* Hall, loc. cit. (not *S. compacta* Kuntze).

A low compact rounded shrub, woody at the base, 30–50 cm. tall, as much as a meter in diameter, its branches sprawling or

ascending, its branchlets scurfy-puberulent, whitened; leaf-blades prevailingly 2–3 cm. long, obovate, rounded at the apex, narrowed at the base to petioles 5–15 mm. long, their margins entire, both surfaces whitened with minute appressed hairs

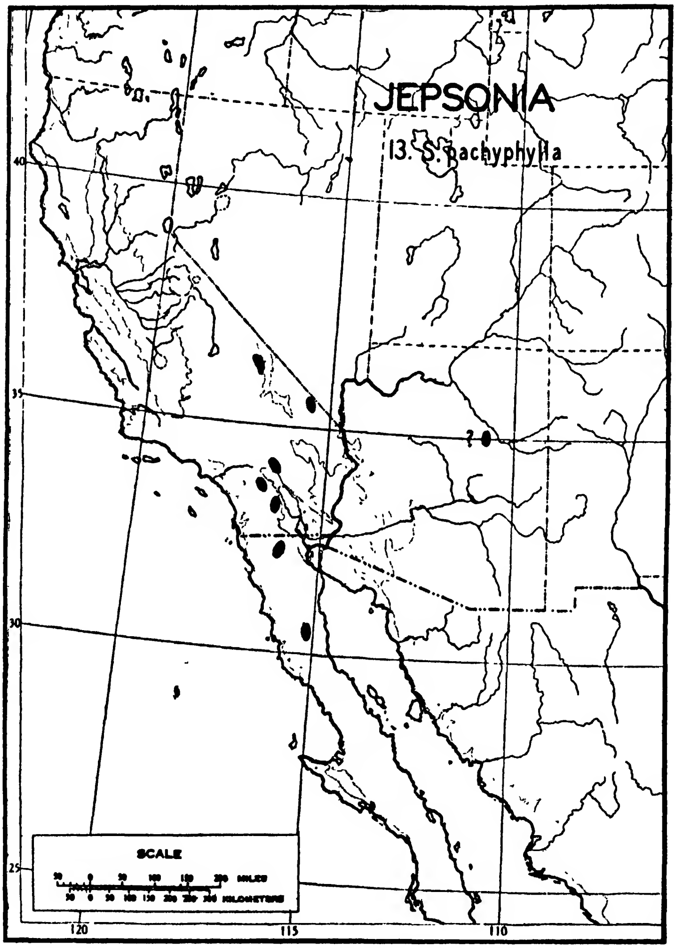


Fig. 8. Showing distribution of *S. pachyphylla.*

especially in youth; flowers several in sufficiently dense glomerules disposed usually in a compact spike 5–10 cm. long, 4–5 cm. broad, less often interrupted, 2–5 cm. distant, subtended by showy usually purple bracts mostly 1–2 cm. long, as much as 3 cm., obovate or oblong, usually rounded-truncate at the apex,

more or less ciliate on the margins, for the rest either glabrous and somewhat shining or hirtellous, hardly pilose; flowering calyces nearly cylindrical, 8–13 mm. long, pubescent, hispidulous within, the teeth of the lower lip 1–3 mm. long, mostly deltoid, acute, sometimes weakly spinose, nearly free, those of the upper lip entirely joined, 3–6 mm. tall, the lip truncate, rarely somewhat retuse; corolla dark violet-blue, rarely rose-color, its tube 15–22 mm. long, cylindrical, pubescent within above the middle, densely and transversely pilose-annulate below, the lobes of the upper lip 4–6 mm. tall, joined to the middle, the middle lobe of the lower erose, emarginate; stamens seated in the throat, the connective equalling the filament, the joint sufficiently obvious; posterior style branch shorter.

This species ranges widely but is localized. In the Panamint Mts. it occurs frequently and even abundantly in the *Juniperus utahensis-Pinus monophylla* formation or even below this, ranging from about 5000 feet in Emigrant Canyon to 10,000 feet or more at the saddle near Eagle Spring on Telescope Peak. Here it enters the zone occupied by *Pinus aristata* and *P. flexilis*. It is known from Towne Pass, Upper Wild Rose Canyon, Upper Hanaupah Canyon, and Telescope Peak. In the San Bernardino, San Jacinto, and Santa Rosa Mountains it lies chiefly in the more arid yellow pine belt, ranging into the juniper and piñon belt. In the San Bernardino Mountains it is known from Seven Oaks, Upper Santa Ana Canyon, top of Cushenberry Grade, Holcomb Valley, 2 mi. e. of Fawnskin, Upper Fish Cr., Cactus Flat, Quail Springs, Black Rock Canyon near Warren's Well, north slope of Sugar Loaf Mt., Bear Valley, Johnson Grade below Baldwin Lake, Big Meadows, Brown's Flats. In the San Jacinto Mountains it is known from the vicinity of Tauquitz Valley and Hidden Lake, and from the north side of San Jacinto Peak. In the Santa Rosa Mountains it is known from the vicinity of Santa Rosa and near Vandeventer Flat. It has recently been found by Wolf at Pachalka Spring and on the north side of the main peak of Clark Mt. In Lower California it occurs with yellow pine, as far as recorded, between Ojos Negros and Neji Rancho, and in the San Pedro Martir at La Grulla, La Encantada, and Vallecitos. I have ob-

served the species growing with *S. carnosa* in Wild Rose Canyon and on Cactus Flat, but due presumably to the difference in flowering period, no hybrids are formed. It evidently occurs with *Salvia apiana* in the Santa Rosa Mountains. *Artemisia tridentata* is an associate in the Panamint, San Bernardino, and San Jacinto Mts. A specimen collected by Marcus Jones in 1929 is said to have been obtained at the crater near Winslow, Arizona. This extension of range should be verified.

14. **S. carnosa** Dougl. ex Benth. in Bot. Reg. **17**: *t. 1469.* 1831, based upon a specimen collected by Douglas "on clayey banks of the Columbia and plains from Walla Walla to Spokane and on the south to the Sources of the Missouri"; the type is in the herbarium of the Royal Botanic Gardens at Kew.

A small erect shrub 30–70 cm. tall, its branchlets scurfy-puberulent, often whitened, sometimes pilose with spreading hairs in the inflorescence; leaf-blades prevailingly 1–2 cm. long, rarely 3–4 cm., oblanceolate or even linear or rotund, mostly obovate, rounded or retuse at the apex, narrowed at the base to petioles mostly 5–8 mm. long, entire, both surfaces silvery with a minute close puberulence especially when young; flowers many in sufficiently dense glomerules, disposed in short interrupted spikes, usually moniliform, less often congested, subtended by ovate-rotund usually colored bracts, these ciliate, puberulent or nearly glabrous, sometimes pilose, sometimes entirely glabrous, venulose and somewhat shining; flowering calyces turbinate, thin, hirtellous or pilose, usually ciliate, hispidulous within, the teeth of the lower lip nearly free, ovate, obtuse or weakly mucronate, those of the upper either wholly joined, the lip 1.5–2 mm. tall, rotund-truncate, or even retuse, or free nearly to the middle, either obtuse or weakly mucronate, about 1 mm. long; corolla blue, its tube cylindrical, 5–10 mm. long, pubescent within above the middle, but scarcely annulate, the upper lip 2–3 mm. tall, its lobes joined about to the middle, the middle lobe of the lower erose, often furcate; stamens seated in the throat, the connective somewhat shorter than the filament, the connection obvious; posterior style branch shorter.

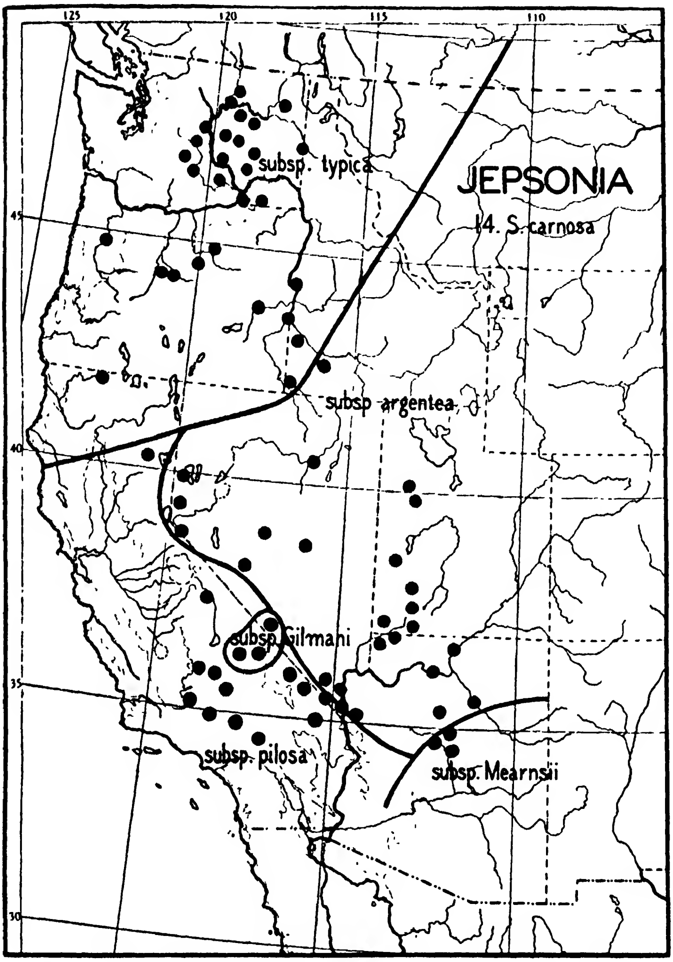


Fig. 9. Showing distribution of *S. carnosa* and its subspecies.

KEY TO THE SUBSPECIES

Leaves oblanceolate or linear, 2–4 mm. broad (see also subsp. *typica*)........ ....subsp. (b) *Mearnsii*

Leaves obovate or spatulate, rarely oblanceolate, for the most part more than 4 mm. broad.

Leaf-blades usually oval or elliptical, rarely obovate, prevailingly 1.5–3, rarely 4 cm. long....................................subsp. (a) *typica*

Leaf-blades usually rotund or spatulate, abruptly narrowed to the petioles, mostly 4–15 mm., rarely 20 mm. broad.

Bracts pilose on the outer surfaces; glomerules mostly 3–4, moniliform but usually approximate.............................subsp. (e) *pilosa*

Bracts usually glabrate except for the ciliate margins; glomerules mostly 2–3.

Glomerules mostly about 1.5 cm. in diameter, usually 0.5–1.5 cm. distant on slender peduncles............................subsp. (d) *Gilmani*

Glomerules mostly 1.5–2.5 cm. in diameter, generally crowded........ ....subsp. (c) *argentea*

This species ranges from the upper Columbia southward along the eastern base of the coastal cordillera and in the mountains of the Great Basin to the northern slopes of the coastal cordillera of southern California and eastward in Arizona almost to Flagstaff. It occurs primarily in association with *Artemisia tridentata,* verging toward the juniper-pine association.

14a. subsp. **typica** Epl. nom. nov., based upon the Douglas specimen at Kew.

Audibertia incana Benth. in Bot. Reg. **17:** *t. 1469.* 1831, based upon a specimen collected by Douglas on the upper course of the Columbia River; the type is in the herbarium of the Royal Botanic Gardens at Kew.

Audibertiella incana Briq. in Bull. Herb. Boiss. **2:** 73. 1894, based upon the same.

Ramona incana Briq., op. cit. 440. 1894, based upon the same.

Salvia carnosa var. *typica* Munz in Bull. S. Calif. Acad. Sci. **26:** 21. 1927, based upon the same (excluding Californian citations).

Upper branchlets hispidulous between the glomerules; leaf-blades mostly oval or elliptic, sometimes obovate, sometimes oblanceolate, 1.5–3, rarely 4 cm. long, gradually narrowed to the petioles and usually twice their length or more; mature glomerules usually 2–2.5 cm. in diameter, usually 3–4 in an interrupted spike, for the most part less than 1 cm. distant, subtended by opaque usually greenish hispidulous-ciliate bracts, their veins scarcely prominent.

This subspecies is known to me only from herbarium material save for a casual acquaintance years ago near Spokane. It is apparently a component of the *Artemisia tridentata* formation ranging into the juniper belt, occurring mostly between 2000 and 3000 feet.

Following are localities from which the subspecies has been gathered:

WASHINGTON: OKANOGAN: Omak, Soap Lake, Brewster; STEVENS: Loon Lake; CHELAN: Wenatchee; DOUGLAS: Egbert Springs; LINCOLN: Almira, Odessa; SPOKANE: Spokane Falls, Spokane; KITTITAS: Ellensburg; GRANT: Wilson Cr., Soap Lake, Vantage, between Ephrata and Coulee City; YAKIMA: Donald, Snipes Mt. near Yakima, Yakima R.; BENTON: Rattlesnake Mts.; FRANKLIN: Kahlotus; WALLA WALLA: near Wallula, Walla Walla.

IDAHO: WASHINGTON: Weiser; OWYHEE: Reynolds Cr.

OREGON: WHEELER: Mitchell; GRANT: Mt. Kimberly; CROOK: Maurey's Mts. near Prineville; MALHEUR: near Adrian.

CALIFORNIA: rocky slopes along the Klamath R. near the Pacific Highway in the juniper belt.

14b. subsp. **Mearnsii** Epl. comb. nov., based upon *Audibertia Mearnsii* Britt., loc. cit.

Audibertia Mearnsii Britt. in Trans. N. Y. Acad. Sci. **8**: 71. 1889, and in the Bull. Torr. Bot. Club **16**: 202. 1889, based upon a specimen collected by Mearns in Arizona near Fort Verde; the type is in the herbarium of the N. Y. Bot. Garden.

Branchlets more or less hispidulous between the glomerules; leaf-blades oblanceolate or linear, 1–2 cm. long, 2–4 mm. broad, gradually narrowed to obscure petioles, mature glomerules usually 2–2.5 cm. in diameter, for the most part 2, about 1 cm. distant in an interrupted spike, or solitary, subtended by glabrous purple shining venulose bracts.

This subspecies is known to me only from very inadequate herbarium material. It is known to occur at three places only: 10 miles east of Jerome Junction (now Copper Station, 1 mi. east of Chino Valley P. O.), at Schuerman's near Sedona, and on the sides of small canyons in limestone near Fort Verde, all in Arizona. It may be highly localized (for I was unable to find it in this region when searching for it) and presumably occurs in association with mesquite.

14c. subsp. **argentea** Epl. comb. nov., based upon *Audibertiella argentea* Rydb., loc. cit.

Audibertiella argentea Rydb. in Bull. Torr. Bot. Club **36**: 683. 1909, based upon a specimen collected in Arizona at Mokiak Pass by Palmer (no. 395); the type is in the herbarium of the N. Y. Bot. Garden.

Branchlets usually hispidulous between the glomerules; leaf-blades usually 8–15 mm., even 20 mm. in diameter, obovate or rotund, abruptly narrowed to petioles somewhat shorter; glomerules usually 2–3, usually congested, sometimes into a compact spike, rarely 1 cm. distant, subtended by usually glabrous, venulose, shining purple or blue bracts.

This subspecies is known to me from herbarium material only. The following are localities from which it is recorded; it ranges higher than the other subspecies and probably occurs in the *Artemisia* and the piñon associations:

IDAHO: OWYHEE: Bruneau.

UTAH: TOOELE: Granite Mts., 5000 ft.; JUAB: Dugway Range, near Detroit, 21 mi. west of Sulphur Springs; BEAVER: Wa Wa; IRON: Cedar Canyon, 6800 ft.; WASHINGTON: Valley of the Virgin near St. George, Santa Clara Valley, 5000 ft., Beaverdam Mts., Zion Canyon, Springdale.

NEVADA: WASHOE: Virginia City, hills n. e. of Reno, 6000 ft., Truckee Desert, 4500 ft., Pyramid Lake; DOUGLAS: near Minden; MINERAL: Candelaria; NYE: Currant, Monitor Valley, 5500 ft.; EUREKA: Palisade; CLARK: Los Vegas Mts., Indian Spring of Charleston Mts., 4000 ft., Lee Canyon of Charleston Mts., 8700 ft.

ARIZONA: MOHAVE: House Rock, Mokiak Pass, Union Pass, Pagumpa at head of Grand Wash; COCONINO: Bright Angel and Hermit Trails of Grand Canyon, Willow Spring, near Flagstaff; 50 miles south of Lee's Ferry.

CALIFORNIA: MONO: Topaz; INYO: Nelson Range near Lee's Pump; (?) RIVERSIDE: near Daggett.

14d. subsp. **Gilmani** Epl. subsp. nov., based upon a collection made by Epling and Gilman in the Panamint Mts. (Piñon Mesa, Wild Rose Canyon); the type is in the herbarium of the University of California (Los Angeles).

Branchlets hispidulous or sometimes pilose between the glomerules; leaf-blades prevailingly 4–7 mm. in diameter, rotund or spatulate, abruptly narrowed to petioles 2.5 mm. long; mature glomerules usually about 1.5 cm. in diameter, sometimes solitary, mostly 2–3 in interrupted spikes, .5–1.5 cm. distant, borne on slender peduncles, subtended by rather opaque, rarely shining bracts which are glabrous or hispidulous, rarely pilose, and usually rose-colored.

It is a pleasure to associate with this plant of the Death Valley Region the name of Mr. French Gilman, curator of the botanic garden in Death Valley and long-time student of the flora and fauna of the Sonoran desert. I am indebted to Mr. Gilman

for notes regarding the distribution of Death Valley and Panamint Labiatae.

This subspecies occurs just at the lower margin of the juniper-piñon association ranging chiefly in the *Artemisia* association from about 3000–7000 feet. It intermixes occasionally with *S. pachyphylla* (Wild Rose Canyon) but, perhaps due to the differences in flowering time, apparently does not hybridize with it.

It is known from the following localities:

CALIFORNIA: INYO: Panamint Mts. (Ubehebe, Panamint Canyon, Wild Rose Canyon, Hanaupah Canyon, Suprise Canyon), Argus Mts. (Shepherds Canyon).
NEVADA: CLARK: Valley of Fire; ESMERALDA: Goldfield.

The specimens cited from Nevada may rather be subsp. *argentea* but seem to be this clearly, especially the Goldfield specimen. Specimens from the Providence and New York Mountains, as well as near Chloride, are more or less intermediate.

14e. subsp. **pilosa** Epl. comb. nov., based upon *Audibertia incana* var. *pilosa* Gray, loc. cit. Plate 25.

Audibertia Dorrii Kellogg in Proc. Calif. Acad. **2**: 190. *fig. 57.* 1863, based upon a specimen collected by C. H. Dorr, presumably near Virginia City, Nevada; the type, formerly in the California Academy of Sciences, is lost.

Audibertia incana var. *pilosa* Gray, Syn. Fl. N. Am. ed. 2, **2**: pt. 1: 461. 1886, based upon a specimen collected by the Parish brothers in the San Bernardino Mts. of California; the type is in the Gray Herbarium.

Salvia pilosa Merriam in N. Am. Fauna **7**, pt. 2: 322. 1893, based upon the same.

Audibertiella Dorrii Briq. in Bull. Herb. Boiss. **2**: 73. 1894, based upon *Audibertia Dorrii* Kellogg, loc. cit.

Ramona Dorrii Briq. in Engler u. Prantl, Nat. Pflanzenf. IV. IIIA. 287. 1897, based upon the same.

Ramona pilosa Abrams in Bull. N. Y. Bot. Gard. **6**: 443. 1910, based upon *Audibertia incana* var. *pilosa* Gray, loc. cit.

Salvia carnosa var. *pilosa* Jeps., Man. Calif. 870. 1925, based upon the same.

Branchlets hispidulous and frequently pilose between the glomerules; leaf-blades usually rotund, frequently spatulate, usually 7–10 (rarely 15) mm. in diameter, narrowed abruptly to petioles mostly 5–7 mm. long; mature glomerules 1.5–2.5 cm. in diameter, prevailingly 4–5 in interrupted spikes, usually less than 1 cm. distant and often crowded, subtended by purplish or greenish bracts which are strongly ciliate and pilose on the backs with hairs of the same order; at the same time they are hardly opaque but somewhat shining and venulose.

The range in flower size is about the same in all the subspecies except perhaps subsp. *pilosa.* The smallest flowers are found here, particularly in a form with very compact glomerules, such as that collected by Jones near Bishop and by Munz near Deep Creek (no. 11913).

This subspecies occurs in association with *Artemisia tridentata* at the lower margin of the juniper-piñon association often with *Yucca brevifolia,* from about 3500–6000 feet.

Following are localities where it is known to occur:

CALIFORNIA: LASSEN: Hot Springs Peak; MONO: Rock Creek Canyon, 6000 ft.; INYO: near Bishop; KERN: Johannesburg, Antelope Valley, Walker Pass, Onyx, Mt. Pinos; LOS ANGELES: Palmdale, Little Rock Cr. of San Gabriel Mts., Hungry Valley, Vincent, Acton, Lancaster; SAN BERNARDINO: Victorville, Hesperia, San Bernardino Mts. (Cushenbury Grade, Deep Cr.), Providence Mts., 4000 ft., Kelso, Cajon, Ventrigger Spring, 11 mi. s. of Barstow, Hackberry Mt., New York Mts. near Ivanpah, Cima, Kingston Mts.; RIVERSIDE: Little San Bernardino Mts. (Covington Flats, Key's Ranch).

NEVADA: ESMERALDA: Amargosa Desert; CLARK: Goodsprings, Las Vegas, Eldorado Canyon at Nelson, 3000 feet.

15. S. eremostachya Jeps., Man. Calif. 870. 1925, based upon a specimen collected by him in Coyote Canyon, Indian Valley, Riverside Co., Calif.; the type is in Jepson's herbarium.

Plate 26.

An intricately branched shrub about a meter tall or less, its branchlets ashy with spreading glandular hairs, frequently pilose; leaf-blades deltoid-oblong, even linear, mostly 1.5–3.5 cm. long, 4–10 mm. wide, obtuse at the apex, truncate at the base or narrowed to more or less marginate petioles 3–8 mm. long, their margins crenulate, nearly straight, frequently revo-

lute, the upper surface bullate, the lower areolate with raised veins, both hispidulous; flowers few in sufficiently dense glomerules, disposed in interrupted spikes formed of 2–3 glomerules 1–2 cm. distant, subtended by thin rotund-ovate bracts,

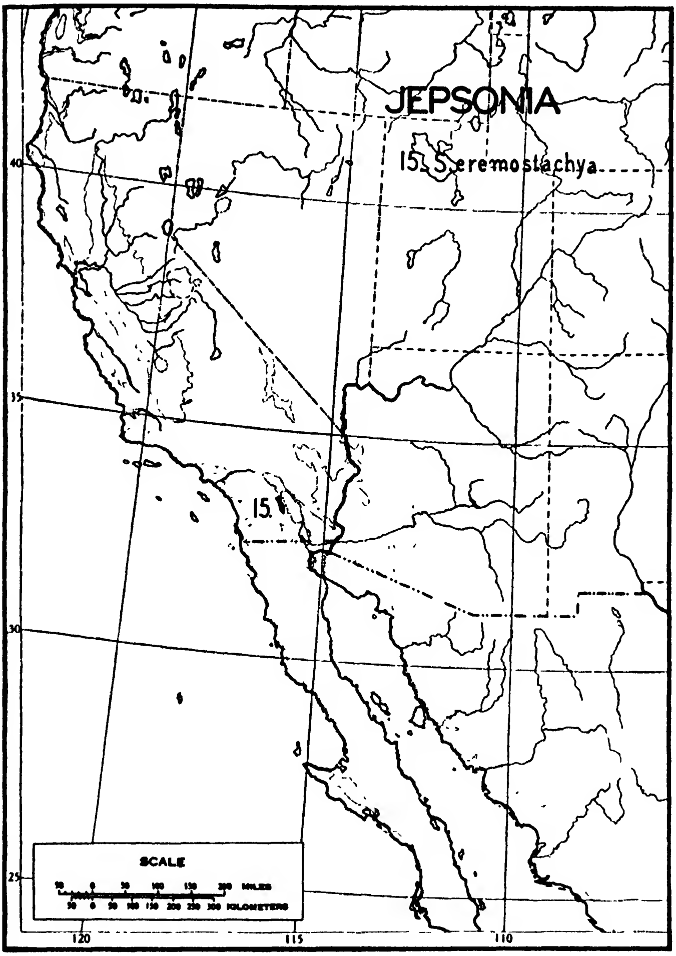


Fig. 10. Showing distribution of *S. eremostachya.*

short-acuminate, glandular, sparingly pilose; flowering calyces glandular-pilose, about 11 mm. long, the lobes of the lower lip free, 3–3.5 mm. long, weakly spinose, those of the upper wholly united unless 2- or 3-spinose at the apex, 4.5–5 mm. tall; corolla

blue or rose color, its tube cylindrical, arcuate, somewhat narrowed near the throat, pubescent within above the middle, 14–17 mm. long, the lobes of the upper lip 4–6 mm. tall, frequently erose, joined in the middle, the middle lobe of the lower lip forked and strongly eroded, rotund; stamens seated in the throat, the connective and filament subequal; posterior style branch shorter.

This species is a component of the *Larrea-Franseria* formation, ranging from 1200 ft. to about 4500 ft. It is known from three localities only: (a) Indian Canyon, Collins Valley, Santa Rosa Mts. near Borego, (b) eastern San Diego Co., Rockhouse Canyon, Santa Rosa Mts., and (c) on the Palms to Pines Highway from just below the piñon belt to the foot of the grade. Its associates are *Larrea mexicana, Prunus eriogyna, Salvia apiana, Salvia Vaseyi, Acacia Greggii, Encelia farinosa, Krameria canescens,* and *Eriogonum fasciculatum.* Hybrids have been observed with the two *Salvia* species mentioned.

16. S. sonomensis Greene in Pittonia **2**: 236. 1892, based upon *Audibertia humilis* Benth., loc. cit. (not *S. humilis* Benth.). Plate 27.

Audibertia humilis Benth., Lab. Gen. et Sp. 313. 1833, based upon a specimen collected in California by Douglas; the type is in the herbarium of the Royal Botanic Gardens at Kew.

Audibertiella humilis Briq. in Bull. Herb. Boiss. **2**: 73. 1894, based upon *Audibertia humilis* Benth., loc. cit.

Ramona humilis Greene in Erythea **1**: 44. 1893, based upon *Audibertia humilis* Benth., loc. cit.

A low perennial creeping herb often forming mats, its flowering stems 15–30 cm. tall, hispid in the inflorescence with spreading more or less glandular hairs, rarely hispidulous with short glandular hairs, softly retrorse-hirsute below; leaf-blades elliptical-obovate, generally 3–6 cm. long, rounded at the apex, attenuate at the base to subequal petioles, their margins crenulate, the upper surfaces bullulate, cinereous, hirtellous, the lower appressed-tomentose, more or less whitened; flowers

numerous in glomerules 1–5 cm. distant, forming interrupted moniliform spikes 10–25 cm. over all, borne on subequal peduncles, subtended by acute appressed elliptical villous bracts; flowering calyces 6–9 mm. long, the lobes of the lower lip free,

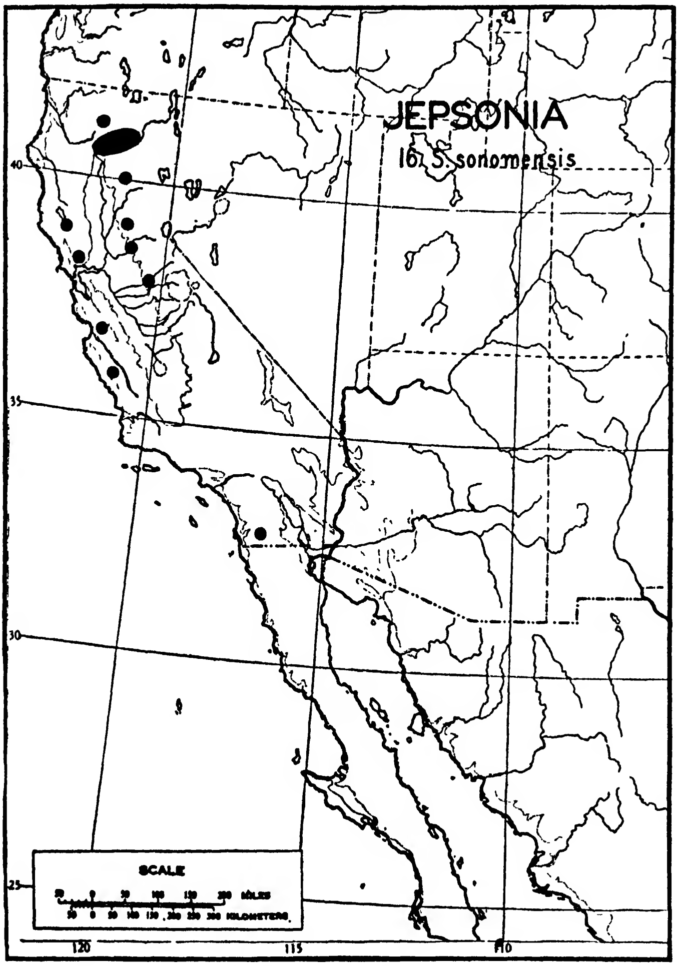


Fig. 11. Showing distribution of *S. sonomensis*.

those of the upper wholly united, trimucronate at the apex; corolla pale violet, its tube 4–8 mm. long, villous-annulate near the middle, the lobes of the upper lip nearly free, 2–3 mm. long, mostly acute, the lower lip thrice as long, its middle lobe rotund,

erose; stamens seated on the base of the lower lip, the filament and connective subequal, their point of connection obscure, entire, the upper staminodia often prominent; style branches very short, the upper somewhat shorter than the lower.

This species occurs generally along the Sierra foothills from Shasta County to Calaveras; along the coast ranges in Lake, Sonoma, and Napa counties; in Monterey County and in San Diego County.

I am familiar with it only in the last where it occurs under thin chamise: *Adenostoma fasciculatum.* In its northern range it apparently occurs with the oak woodland or yellow pine formations or under manzanita within these formations. No hybrids are known, nor does it apparently grow with any other species. The specific localities from which it is known are as follows:

CALIFORNIA: SHASTA: Ydalpom, Kennet, O'Brien Cr., Cow Cr.; SISKIYOU: McCloud, Pit R. Ferry, Mt. Shasta, Sisson, Burney, Bully Hill; BUTTE: Forest Ranch, 2700 ft., Cohasset; NEVADA: Banner Hill, Lake City, Grass Valley; SACRAMENTO: Folsom; CALAVERAS: Mokelumne Hill, Murphy's Camp, Devil's Gulch; LAKE: Lower Lake, Mt. Konocti, 3000 ft.; NAPA: Mt. St. Helena, Calistoga; SONOMA: Sonoma; SAN BENITO: San Juan, Mt. Hood, Fremont's Peak; MONTEREY: Santa Lucia Peak, Tassajara Hot Springs, N. Fork San Antonio R., Arroyo Seco R.; SAN DIEGO: Harper Ranch near Cuyamaca Lake, top of Cuyamaca Peak, Guatay Mt., Descanso Junction.

17. S. Vaseyi Parish in Muhlenbergia **3**: 126. 1907, based upon *Audibertia Vaseyi* Porter, loc. cit. Plate 28.

Audibertia Vaseyi Porter in Bot. Gaz. **6**: 207. 1881, based upon a specimen collected in San Diego Co., Calif., at Mountain Springs by Vasey; the type may be in the Porter herbarium at the Academy of Natural Sciences, Philadelphia.

Audibertiella Vaseyi Briq. in Bull. Herb. Boiss. **2**: 73. 1894, based upon *Audibertia Vaseyi* Porter, loc. cit.

Ramona Vaseyi Briq., loc. cit., 440. 1894, based upon the same.

A low rounded snowy shrub as much as a meter tall, its branchlets minutely incano-puberulent; leaf-blades prevailingly deltoid-ovate, 3–5 cm. long, obtuse at the apex, truncate at the base or abruptly cuneate, their margins crenulate, both

surfaces densely whitened with minute appressed hairs, borne on petioles 5–10 mm. long; flowers many in compact glomerules disposed in moniliform long-peduncled spikes 30–60 cm. long, 3–8 cm. distant, subtended by whitened bracts, the outer ovate,

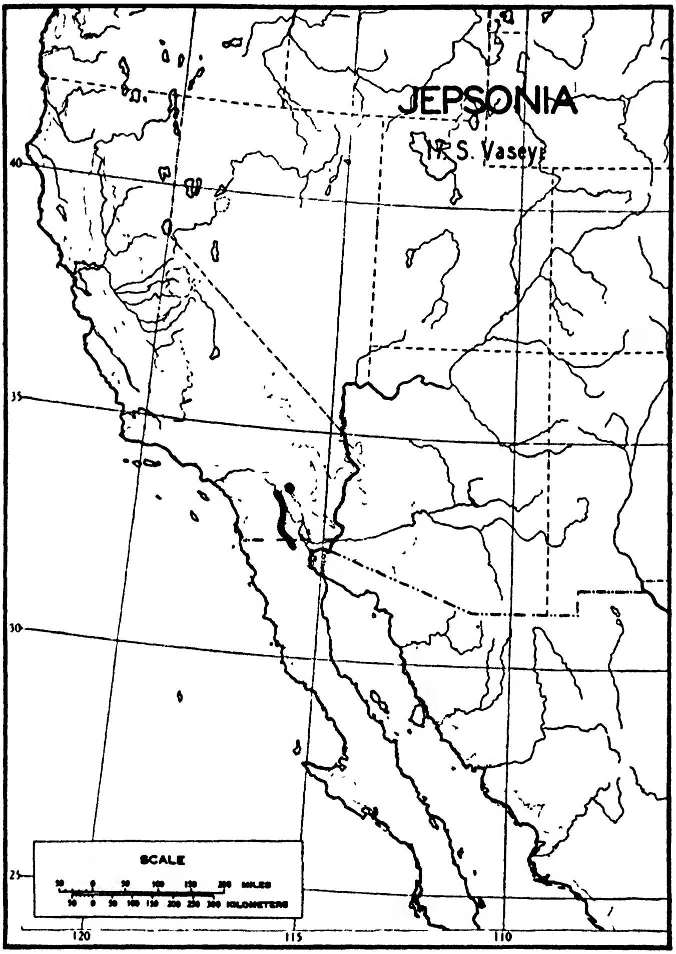


Fig. 12. Showing distribution of *S. Vaseyi.*

the inner lanceolate, all tipped with a stout bristle; flowering calyces whitened with minute hairs, 8–10 mm. long excluding the bristles, the lobes of the lower lip deltoid-ovate, free, drawn into a bristle 3–4 mm. long, as much as 8 mm. long over all,

those of the upper wholly united, the lip drawn into a bristle as long as the body, 5–8 mm. long over all; corolla white, its tube 11–14 mm. long, strongly pilose-annulate within near the middle and vertically compressed, the throat closed, the lobes of the upper lip almost completely joined, the lip rotund, retuse, 3–4 mm. in diameter, the lower lip 7–12 mm. long, the middle lobe obreniform, erose; stamens seated in the throat, the connective somewhat longer than the filament.

This species is a component of the *Larrea-Franseria* formation, its principal associates being *Larrea mexicana, Eriogonum fasciculatum polifolium, Encelia farinosa, Franseria dumosa, Fouquieria splendens,* and *Yucca mohavensis.* It occurs chiefly on the western side of the Colorado Desert from Mountain Spring in San Diego County (and doubtless in Baja California) to Palm Canyon in the San Jacinto Mountains. On the eastern side of the valley it occurs in Morongo Valley (Little San Bernardino Mts.). It is abundant on the Palms to Pines Highway. While doubtless abundant throughout this range it is not otherwise recorded save from Martinez Canyon in the Santa Rosa Mountains, Yaqui Well, and Palm Canyon near Borego. It occurs with *Salvia eremstachya* and *S. apiana* and hybridizes with both.

18. S. apiana Jeps. in Muhlenbergia **3**: 144. 1908, based upon *Audibertia polystachya* Benth., loc. cit. (not *S. polystachya* Ort.). Plates 29 & 30.

Audibertia polystachya Benth., Lab. Gen. et Sp. 314. 1833, based upon a specimen collected in California by Douglas; the type is in the herbarium of the Royal Botanic Gardens at Kew.

Audibertiella polystachya Briq. in Bull. Herb. Boiss. **2**: 73. 1894, based upon the preceding.

Ramona polystachya Greene in Pittonia **2**: 235. 1895, based upon the same.

S. californica Jeps., Fl. W. Middle Calif. 460. 1901, based upon the same (not *S. californica* Brandegee).

S. apiana var. *typica* Munz in Bull. S. Calif. Acad. Sci. **26**: 25. 1927, based upon *S. apiana* Jeps., loc. cit.

S. apiana var. *compacta* Munz, loc. cit., based upon a specimen collected in Riverside Co., Calif., in the Dry Morongo Wash, by Munz and Johnston (no. 5170); the type is in the herbarium of Pomona College.

A snowy shrub 1–2 or even 3 m. tall, its branchlets whitened with minute appressed hairs; leaf-blades either elliptical or oval, mostly 5–10 cm. long, obtuse at the apex, narrowed at the base to petioles 0.5–2 cm. long, their margins crenulate, frequently subentire, both surfaces whitened with very minute appressed hairs; flowers few in lax glomerules, subtended by ovate-lanceolate frequently subspinose bracts mostly shorter than the calyces, spreading or deflexed, disposed in striking elongated panicles as much as 1.5 m. long, the branchlets either ascending or shortened and appressed to the axis, thus forming a spike-like thyrsis or even an apparent interrupted spike; flowering calyces 5–7.5 mm. long, whitened with very minute appressed hairs, the lower teeth mostly free, ovate, about 1.5 mm. long, obtuse or subspinose, the upper wholly united, the lip obtuse, truncate or retuse, hardly mucronate; corolla whitish, commonly speckled with lavender, its tube 5–7 mm. long, pilose in the throat, commonly annulate, the upper lip entire or retuse, 1.5–2 mm. tall, plane, recurved, the lower 8–20 mm. long, abruptly bent at the base and ascending, thus closing the orifice, the middle lobe rotund, erose, cupped, deflexed, 4.5–12 mm. broad; stamens seated on the base of the lower lip, ascending and divaricate, the connective longer than the filament; style deflexed.

This species is an important and characteristic component of the coastal sage formation, ranging into the western margins of the *Larrea-Franseria* formation from Santa Barbara County to about 30 miles north of Punta Prieta in Lower California. It occurs also in isolated colonies within the chaparral (chamisal), the piñon-juniper, and even reaches to the yellow pine forest. It has the greatest altitudinal range of any species save perhaps *S. Columbariae.* It occurs very commonly with *Eriogonum fasciculatum.* It may occur with *S. mellifera, leucophylla, Clevelandii, eremostachya, pachyphylla, Vaseyi,*

Munzii, Columbariae, and *carduacea.* It forms hybrids with all but the last two. I have seen it also in the vicinity of but not actually with *S. spathacea, sonomensis, carnosa,* and *mohavensis.* In Lower California it reaches into the *Idria* association.

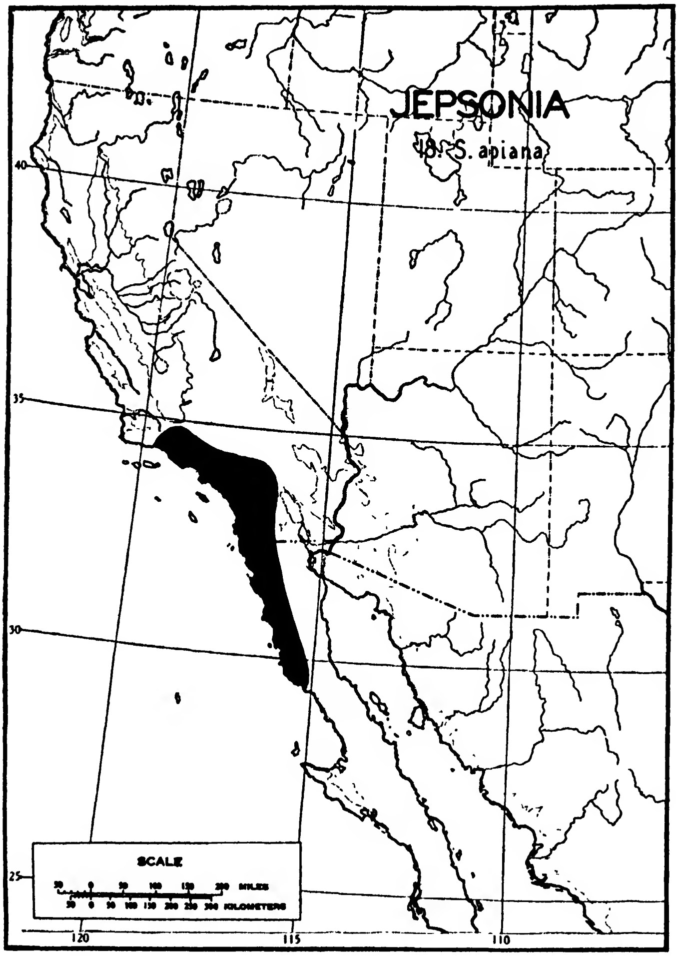


Fig. 13. Showing distribution of *S. apiana.*

It is obviously the most catholic of all the Audibertias. As it occurs along the western margin of the Colorado Desert, it becomes more compact in inflorescence (var. *compacta* Munz) but not otherwise modified. This more compact form is by no

means consistent in its occurrence, however, and is not well defined. Since its range is largely marginal to that of *Salvia Vaseyi,* I have wondered whether these more compact forms might represent slight intermixture with that species, with which clearly defined hybrids do occur.

As the flowers open they tend to have the conformation of the flowers of *S. Vaseyi* or *S. eremostachya.* The elongate lower lip is soon reflexed, however, in most cases. It may not be so reflexed in occasional plants. While usually with a whitish speckled corolla (yellowish in the bud), occasional forms occur with a fairly well-defined bluish tinge.

Following are localities where the species may be found:

CALIFORNIA: SANTA BARBARA: Santa Barbara Mts. (Billiard Flat), Santa Barbara; VENTURA: Topa Topa Mts., Piru Cr.; LOS ANGELES: San Gabriel Mts. (Big Rock Cr.), Claremont, Los Angeles (Elysian Park), Westwood, Santa Monica Mts., Verdugo Hills, Sierra Madre, Monrovia, Acton, Antelope Valley, Newhall, Mt. Lowe; SAN BERNARDINO: San Bernardino, Cajon Pass; RIVERSIDE: Whitewater, Morongo Wash, Corona, Box Springs, Menifee, Sage, San Jacinto, Ramona, San Jacinto Mts. (Snow Cr.), Massacre Canyon; ORANGE: Rincon, Santa Ana Canyon; SAN DIEGO: Otay Mesa, Coronado Isl., Santa Rosa Mts., Flinn Springs, Lake Hodges, Mountain Springs, Jacumba, San Felipe, Vallecitos, Mason Valley, La Jolla, Oak Grove, Palomar Mt., Witch Cr.; SANTA CATALINA ISLAND.

BAJA CALIFORNIA: San Pedro Martir, San Antonio Canyon, Sacaton, Tijuana, 34 mi. n. of Punta Prieta (furthest south observed), Jaraguay, Cataviña, El Marmol, Arroyo Seco between Johnson Ranch and San Antonio Mesa.

HYBRIDS

When two or more species of *Salvia* are found growing with or near each other occasional or sometimes numerous plants may be found which are more or less intermediate between these species. While it is true that, to my knowledge, no hybrids have as yet been produced by hand, it seems hardly other than that these intermediate plants are natural hybrids, particularly since they are seldom, if ever, found apart from the supposed parent species. I consider them to be such. In habit, in foliage, in pubescence, and in floral characteristics they are generally intermediate, although in some cases may resemble one parent or the other very closely, only small clues indicating the compound heritage. They are not markedly more robust than the parents although sometimes with somewhat larger

flowers. In fact, the foliage is reduced in size if anything. Whether they are fertile is unknown but by inference from their infrequence and association with the parent species, which are otherwise quite constant, it would appear that they are not. Apart from their intermediate nature I have observed several facts of interest, namely, that the branched pubescence of *S. leucophylla* is dominant, always (in my experience) appearing in the hybrid, although modified and not so luxuriant, and that the lower end of the connective, which in the parents is completely lost, is slightly but definitely developed in occasional hybrids. With one exception, namely *S. apiana* × *pachyphylla,* the anthers appear normal. There is some slight suggestion that hybridization produces an elongation to the upper calyx lip as in *S. Columbariae* and *S. Vaseyi.*

A drawing has been included (fig. 14) which will indicate to a certain degree the intermediate nature of the average hybrid. It shows flowers from *S. Columbariae* and *S. mellifera* and the intermediate (known as *S. bernardina).* It will be seen that the calyx is about intermediate; the corolla of the hybrid is more nearly that of *S. Columbariae,* the stamens more nearly those of *S. mellifera.* The resemblance of this hybrid flower to the flower of *S. Munzii* is remarkable and, to me, suggestive of the probable course of speciation within the section. I have seen similar hybrids, almost certainly between *S. eremostachya* and *S. apiana,* which strongly suggested *S. Vaseyi* in habit and structure.

While in so far as observation has permitted, it would appear that the hybrids usually occur anywhere in the range of the parent species, *S. bernardina (S. Columbariae* × *mellifera)* appears to be restricted to the vicinity of San Bernardino, although the parents occur together over wide areas.

The following have been observed:

A. *S. apiana* × *Clevelandii (S. Palmeri)*
B. *S. apiana* × *mellifera*
C. *S. apiana* × *leucophylla*
D. *S. apiana* × *pachyphylla*
E. *S. apiana* × *Munzii*

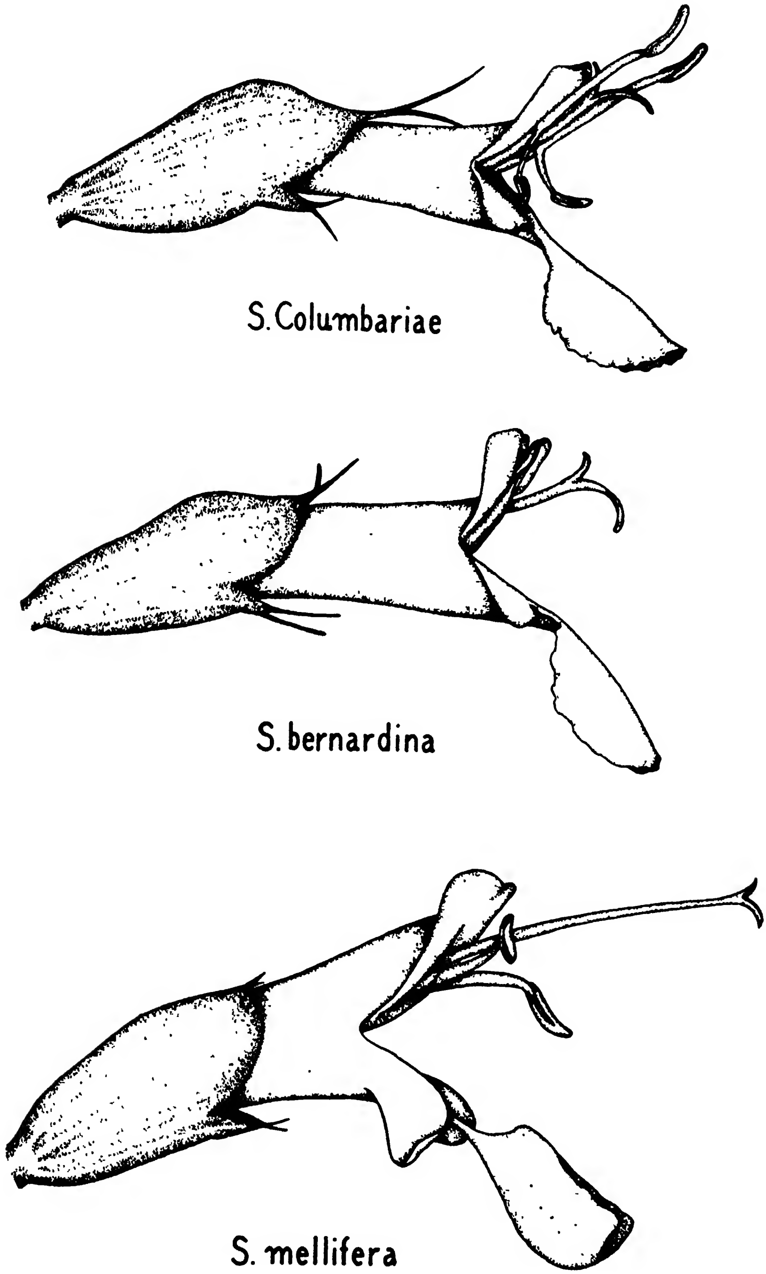


Fig. 14. Flower of *S. bernardina* compared with those of its parents.

F. *S. apiana × Vaseyi*
G. *S. apiana × eremostachya*
H. *S. leucophylla × mellifera*
J. *S. Columbariae × mellifera (S. bernardina)*
K. *S. Clevelandii × leucophylla*
L. *S. eremostachya × Vaseyi*

A. **S. apiana × Clevelandii**

Audibertia Palmeri Gray in Bot. Calif. **1**: 601. 1876, based upon a specimen collected on Tighes Ranch in San Diego Co., Calif., by Palmer; the type is in the Gray Herbarium.

S. Palmeri Greene in Pittonia **2**: 236. 1892, based upon the preceding (not *S. Palmeri* Gray).

Audibertiella Palmeri Briq. in Bull. Herb. Boiss. **2**: 73. 1894, based upon the same.

Ramona Palmeri Briq., loc. cit., 440. 1894, based upon the same.

In habit this hybrid is about intermediate between its parent species, having the foliage more nearly that of *S. Clevelandii,* though perhaps more elongated, the flowering stems being more elongated, after the habit of *S. apiana.* The inflorescence is about intermediate, the glomerules being usually smaller and instead of being solitary are numerous, and it is branched. The pubescence of the plant would not at first glance appear different, though whiter in some forms, especially in the younger leaves, these becoming glabrate in age, contrary to *S. apiana.* The petioles are longer than in *S. Clevelandii.* The calyces both in form and pubescence are scarcely different from those of *S. Clevelandii.* The corollas are about midway, suggesting *S. Vaseyi* in habit, the upper lip being nearly entire, about 5 mm. tall, the lower about 9–10 mm. long, lightly cupped, the middle lobe larger in proportion than in *S. Clevelandii.* The pilose annulus is seated at about the middle of the tube, in other words in an intermediate position.

B. **S. apiana × mellifera**

In habit this is a more robust plant than *S. mellifera* with more elongate branches, thus resembling *S. apiana.* The foli-

age is about intermediate in size and texture, being usually more pubescent than *S. mellifera* but not so white as *S. apiana.* The closeness and density of the pubescence is more nearly that of *S. apiana.* The inflorescence is about intermediate, being more branched than is usual with *S. mellifera,* the branchlets tending to be erect as in the thyrsis of *S. apiana,* rather than to spread in an arcuate manner as in *S. mellifera.* The pubescence of the bracts and calyces is finer and more appressed than in *S. mellifera,* thus resembling *S. apiana.* The flowers are intermediate, both in size and form. The stamens project straight from the tube instead of ascending under the upper lip as in *S. mellifera* and are longer. The corolla-tube is pilose-annulate below or near the middle, more broadly and coarsely than in *S. mellifera.*

C. **S. apiana × leucophylla**

A stout plant resembling *S. apiana* more in habit, with the stout elongated flowering stalks of that species. The pubescence throughout is that of *S. leucophylla* but the foliage is not so whitened. The leaves are intermediate in texture and more or less truncate at the base, but their margins are more convex than in *S. leucophylla.* The inflorescence is panicled but distinctly glomerulate, the glomerules being more compact and larger than in *S. apiana.* The calyces have the form of those of *S. leucophylla* but bear two small teeth partly adnate to the upper lip which is usually entire. The corollas are about intermediate, having a pilose annulus above the middle of the tube as in *S. leucophylla* and a plane middle lobe which is broader than in *S. leucophylla.* The stamens are declined as in that species.

D. **S. apiana × pachyphylla**

Known to me only from a single herbarium specimen: *Munz 5829,* collected in the Santa Rosa Mountains. The peculiar nature of the calyx, almost wholly that of *S. pachyphylla,* the oblong and thin bracts, the intermediate nature of the foliage in texture and form, the intermediate nature of the inflorescence and of the corolla, all suggest most strongly such a hybrid. The corollas vary considerably in size and length of tube,

are pilose below the middle of the tube, the upper lip is entire or notched, the lower lip is variable in size. The peculiar geniculate character of the stamens is unusual as well as the apparently incomplete development of the anthers which in most hybrids are apparently normal. Some seeds, however, were beginning their development.

E. **S. apiana × Munzii**

In the region of Sacaton and San Antonio Mesa in northern Lower California *S. apiana* and *S. Munzii* frequently occur together. Two plants of hybrid origin were found, one at the entrance to Cedar Cañon near San Antonio Mesa and one on the second ridge north of San Vicente on the Sacaton road. They are about intermediate and resemble the hybrids of *S. apiana* and *mellifera.*

F. **S. apiana × Vaseyi**

An undoubted hybrid between these parents was found growing with abundant *S. Vaseyi* at Palm View on the Palms to Pines Highway and about a mile from abundant *S. apiana compacta.* As might be expected from the general similarity of the parents, it was not readily detected. In habit and in flowers it was about intermediate, the flowers being distinctly glomerulate. One is led to wonder whether *Salvia apiana* var. *compacta* represents, in part at least, an intermixture with *S. Vaseyi,* since the two occur in approximately contiguous range along the western margin of the Colorado Desert. The corollas of *S. apiana* var. *compacta* are often larger than those of the typical species.

G. **S. apiana × eremostachya**

These parents were found growing together freely at a point .6 mi. below the Shumway Road, Palms to Pines Highway (from Idylwild to Palm Springs). This point marked the upper limit of *S. eremostachya* and the lower limit of *S. apiana.* About a mile further down the highway occurs the upper limit of *Salvia Vaseyi. S. apiana* was mostly of the more compact form although some specimens were scarcely more so than coastal forms. There was some slight suggestion in foliage

habit that the more compact forms might represent intermixtures with *S. Vaseyi.* With the first-named parents several hybrid plants were found. While more or less intermediate in general habit, one was scarcely different from *S. eremostachya* in many ways. In general they suggested a plant with the foliage of *S. leucophylla* and the inflorescence of *S. Vaseyi.* The pubescence of the leaves was like that of *S. apiana* in type but coarser; that of the flowers intermediate and less glandular than of *S. eremostachya.* The corollas were mostly larger than with either parent. Growing with these parents and hybrids was a single plant hard to identify. Generally of the aspect of *S. Vaseyi,* its leaves were corrugated and much greener. The flowers were essentially those of *S. Vaseyi,* but still not typical. It may represent *S. Vaseyi* with a slight intermixture of *S. eremostachya,* but was not at all like the presumed hybrid of this parentage found several miles lower on the highway.

H. **S. leucophylla × mellifera**

In habit much like *S. mellifera* but with usually larger leaves more oblong and cuneate at the base but hardly truncate, the texture more nearly that of *S. mellifera,* the pubescence branched but lacking the density of that of *S. leucophylla.* Inflorescence stouter than in *S. mellifera,* but frequently branched after the habit of that species, the glomerules larger, more compact, the pubescence of the bracts and calyces branched. Calyces resembling those of *S. leucophylla,* but the two lower teeth present. Corolla-tube mostly 10–11 mm. long, strongly pilose-annulate just above the middle, the upper lip intermediate, the lower cupped more after the habit of *S. mellifera.* Stamens thrust forward, exserted 5–8 mm.

J. **S. Columbariae × mellifera**

S. bernardina Parish in Bull. Calif. Acad. **1**: 211. 1885, based upon a specimen collected by Parish near San Bernardino, Calif.

S. Columbariae var. *bernardina* Jeps., Man. Calif. 869. 1925, based upon the same.

A low shrub with rather fleshy branchlets clothed above with spreading hairs, its leaves about intermediate between those

of the parent species, having the approximate outline and texture of *S. mellifera* but pinnately lobed, the pubescence being rougher, less appressed than in *S. mellifera,* and more abundant than in *S. Columbariae.* Glomerules about intermediate, 2–3 in a spike, these occasionally ternate, the bracts more rotund than those of *S. mellifera* but less so than those of *S. Columbariae,* these and the calyces more villous than either of the parents, the latter without the tuft of hairs on the back as in *S. Columbariae* and more similar to those of that species. Corolla intermediate in form, the stamens being those of *S. Columbariae* but less exserted and the secondary anthers somewhat more dwarfed. The corolla-tube is annulate near the middle as in *S. mellifera* but less sharply so. This hybrid is known to me from herbarium specimens only. While the parent species occur together frequently, the hybrid is rare.

K. S. Clevelandii × leucophylla

A single specimen has been seen at the Rancho Santa Ana Botanic Garden where the two parent species are growing together (the former planted). It is a rounded shrub about intermediate in habit and in foliage, the inflorescence being interrupted-spicate with more remote glomerules than in *S. leucophylla.* The glomerules themselves and the flowers are nearly those of *S. Clevelandii,* the corolla being paler blue, smaller (its tube 11–12 mm. and annulate below the middle), and of a somewhat different conformation. The branched trichomes of *S. leucophylla* appear unchanged on the foliage; those of the calyces are intermediate. The odor is more like that of *S. leucophylla.*

L. S. eremostachya × Vaseyi

A single plant was found on the Palms to Pines Highway 1.5 mi. above the viaduct at the foot of the grade. It was growing with abundant *S. Vaseyi.* The habit was much like that of *S. eremostachya,* the inflorescence being glomerulate but not elongate. The foliage was intermediate; the flowers were not unlike those of *S. eremostachya* but with less glandular pubescence.

INDEX

New names are printed in **bold-face** type; previously published names in ordinary type; and synonyms in *italics*.

Explanation of Plate

PLATE 12

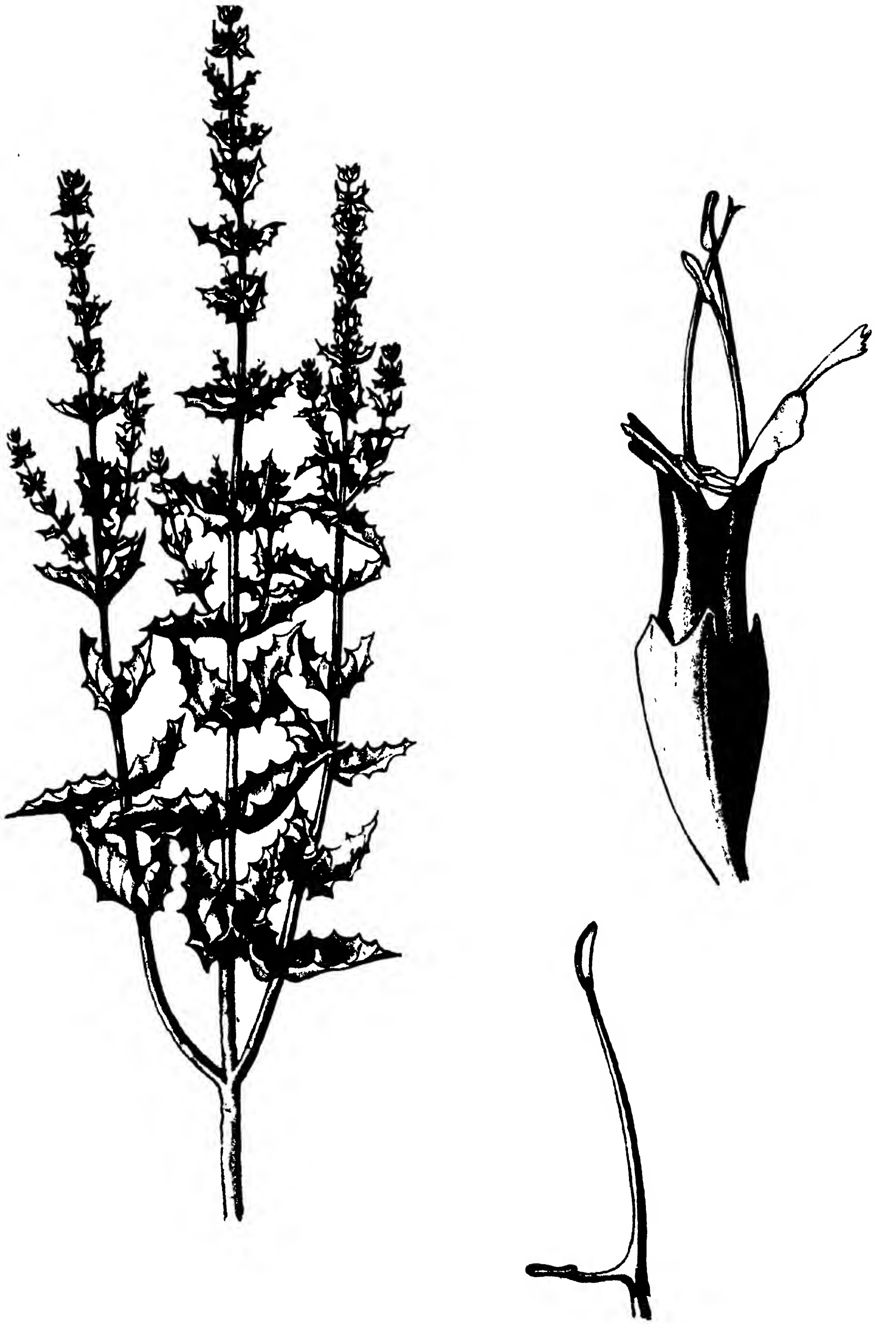
Salvia carduacea.

EPLING — THE CALIFORNIAN SALVIAS

Explanation of Plate

PLATE 13

Salvia californica.



EPLING — THE CALIFORNIAN SALVIAS

Explanation of Plate

PLATE 14

Salvia funerea.

In the upper right-hand corner is a branchlet in fruit. The dense, branched hairs form a globular, more or less adhesive mass such that the calyces cling to each other and to other objects and are blown by the wind.

EPLING — THE CALIFORNIAN SALVIAS

EXPLANATION OF PLATE

PLATE 15

Salvia Greatae.

EPLING — THE CALIFORNIAN SALVIAS

Explanation of Plate

PLATE 16

Salvia Columbariae.

EPLING — THE CALIFORNIAN SALVIAS

Explanation of Plate

PLATE 17

Salvia spathacea.

The imperfect anther rarely, if ever, bears pollen.

EPLING — THE CALIFORNIAN SALVIAS

EXPLANATION OF PLATE

PLATE 18

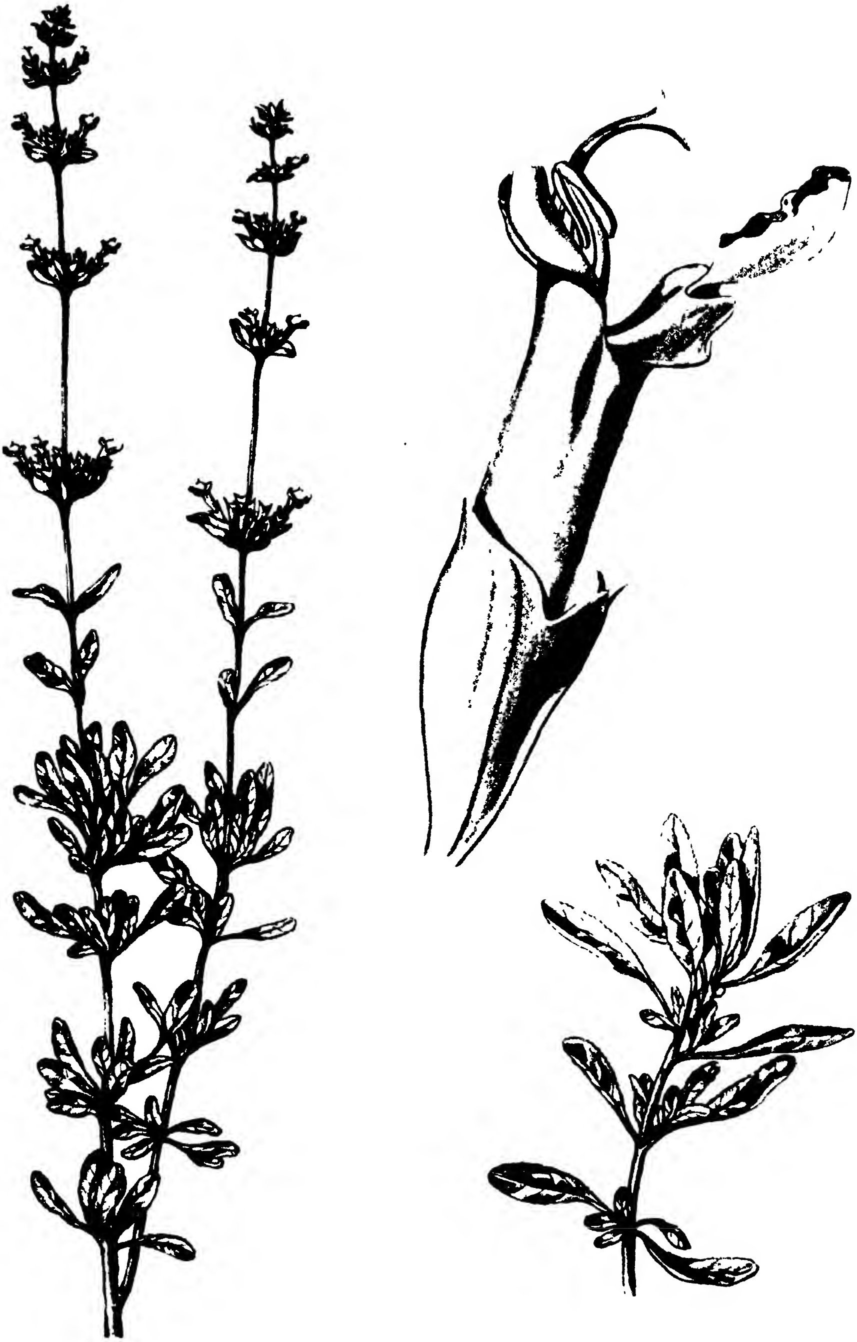
Salvia mellifera.

EPLING — THE CALIFORNIAN SALVIAS

Explanation of Plate

PLATE 19

Salvia Munzii.



EPLING — THE CALIFORNIAN SALVIAS

Explanation of Plate

PLATE 20

Salvia Brandegei.

The flower in this case was reproduced from a boiled specimen. The author has not seen the living plant in flower, but, judging from the few herbarium specimens which have been collected, the stamens are as indicated.

EPLING — THE CALIFORNIAN SALVIAS

EXPLANATION OF PLATE

PLATE 21

Salvia Clevelandii.

The lower lip of the corolla is essentially plane and oblong.

EPLING — THE ÇALIFORNIAN SALVIAS

Explanation of Plate

PLATE 22

Salvia leucophylla.

The lower lip of the corolla is plane and oblong.

EPLING — THE CALIFORNIAN SALVIAS

EXPLANATION OF PLATE

PLATE 23

Salvia mohavensis.

EPLING — THE CALIFORNIAN SALVIAS

Explanation of Plate

PLATE 24

Salvia pachyphylla.

EPLING — THE CALIFORNIAN SALVIAS

Explanation of Plate

PLATE 25

Salvia carnosa subsp. *pilosa*.

EPLING — THE CALIFORNIAN SALVIAS

EXPLANATION OF PLATE

PLATE 26

Salvia eremostachya.

The throat of the corolla is vertically compressed.

EPLING — THE CALIFORNIAN SALVIAS

Explanation of Plate

PLATE 27

Salvia sonomensis.

EPLING — THE CALIFORNIAN SALVIAS

EXPLANATION OF PLATE

PLATE 28

Salvia Vaseyi.

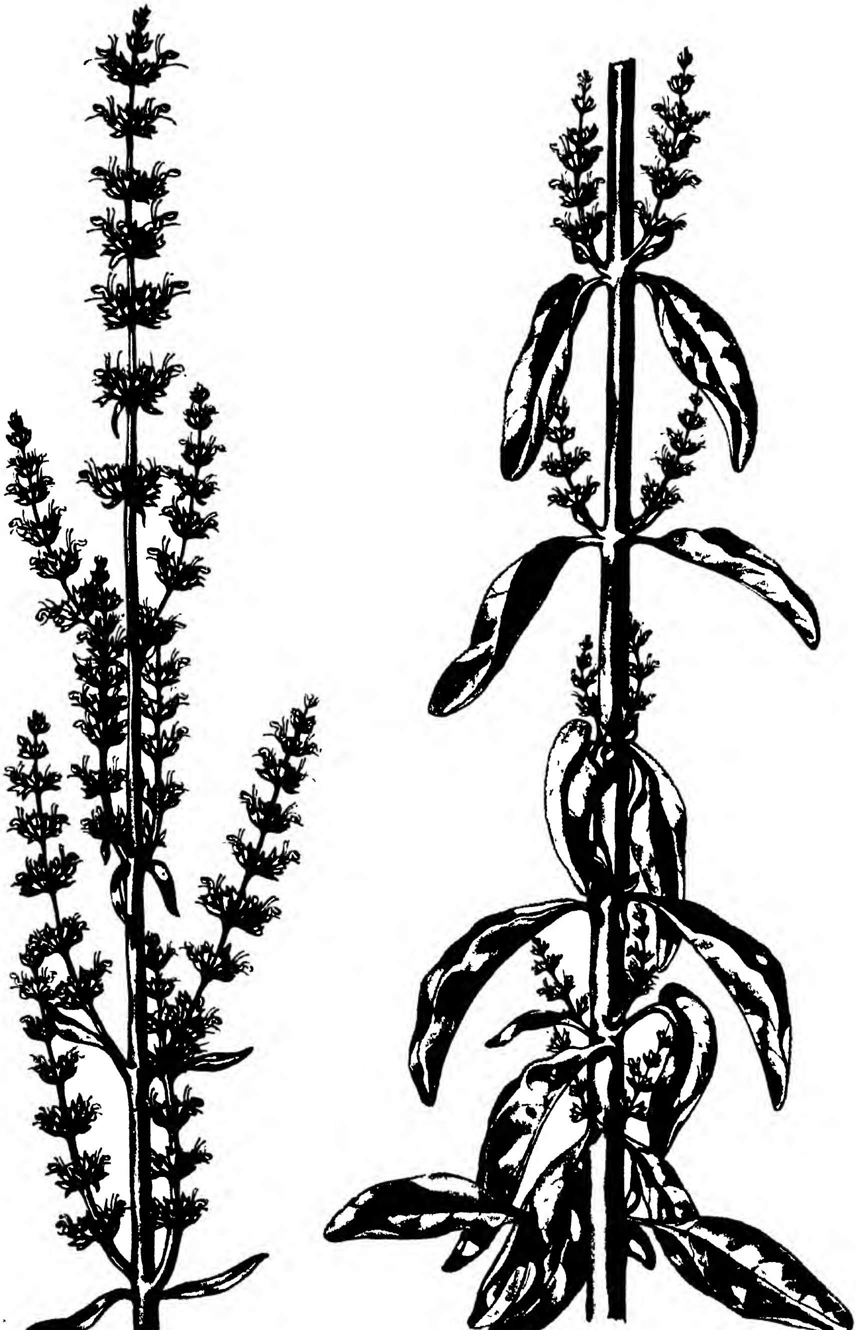
The corolla throat is vertically compressed.

EPLING — THE CALIFORNIAN SALVIAS

Explanation of Plate

PLATE 29

Salvia apiana.



EPLING — THE CALIFORNIAN SALVIAS

Explanation of Plate

PLATE 30

Salvia apiana.

The upper flower is characteristic of early anthesis, the lower lip later becoming reflexed as shown in the lower flower. The first position is seemingly permanent in some cases, however. The throat is more or less compressed vertically.

EPLING — THE CALIFORNIAN SALVIAS

STUDIES IN THE APOCYNACEAE. VII[1]

An Evaluation of the Genera Plumeria L. and Himatanthus Willd.

ROBERT E. WOODSON, JR.
Research Assistant, Missouri Botanical Garden
Assistant Professor in the Henry Shaw School of Botany of Washington University

Even a casual examination of a suite of herbarium specimens of the inclusive genus *Plumeria* will demonstrate that the representations indigenous to America roughly north and south of Panama are of very distinctive appearance. It is true that both groups are constituted of rather small to moderate-sized trees with disproportionally thick, fistulose branches and a spongy, suberized periderm; usually rather large, fleshy, spiral foliage which is very deciduous; and broad inflorescences of handsome, waxy flowers. However, the representation roughly from Panama northward, including two species in northern South America, but particularly abundant in Central America, southern Mexico, tip of peninsular Florida, and the Antilles proper, including the Bahama Islands, and that of South America, from Panama to southern Brazil, are distinguishable at a glance because of the large, petalaceous bracts of the latter.

It has long been known as well that the northern species are characterized by a regular calyx of five equal to subequal lobes, whilst the calyx of the southern species either is not manifest, or is composed of two to five minute appendages of very unequal size and shape. The stems of the northern species also are more swollen, but with lighter wood than those of the southern, which make plants of the two groups easily distinguishable in the field, even when without either flowers or foliage, a condition which frequently occurs. Because of its extreme light-

[1] Issued December 27, 1937.

ness, the wood of the northern species is not valuable commercially, whilst that of the southern species constitutes the timber known as "Sucuúba" in the Amazon valley and contiguous Guiana.

Three species of *Plumeria* were known to Linnaeus, who retained the name from Tournefort: *P. rubra* (Sp. Pl. ed. 1. **1**: 209. 1753), *P. alba* (ibid. 210), and *P. obtusa* (ibid.). All three are of the northern group, and are inhabitants of Central America and the Antilles. It is strange, therefore, with the typical element of the genus so well indicated, that so careful a student as Mueller-Argoviensis (in Mart. Fl. Bras. **6**[1]: 42. 1860) should have considered the large-bracted species typical, and should have suggested that the small-bracted species might constitute a genus separate from *Plumeria!* This confusion was repeated more recently by K. Schumann (in Engl. & Prantl, Nat. Pflanzenfam. **4**[2]: 136. 1895), who grouped both the small-bracted northern species and the large-bracted southern species under the division "Bracteen gross, leicht abfallend. . ." in his key to the species contained in the 'Naturlichen Pflanzenfamilien.'

In the meanwhile the name *Himatanthus* Willd. had been proposed in Roemer & Schultes's 'Systema' in 1819, based upon a large-bracted species from northeastern Brazil, with satisfactory descriptions both generic and specific. *Himatanthus* was not known to Mueller, evidently, and was ignored by Schumann and subsequent writers as a pure synonym for *Plumeria.*

From a somewhat extended study of the North and South American representations, however, it becomes apparent that *Plumeria* and *Himatanthus* should not be considered as congeneric, since they may be distinguished by several important morphological factors as follows:

Inflorescence fastigiately thyrsiform, the secondary branches irregularly congested; bracts inconspicuous, scarious, caducous, not subtended by pectinate adaxial glands at the base; calyx-lobes always manifest, essentially equal, the tips obtuse to very shortly acuminate, always glandular; ventral loculi of the anthers conspicuously protuberant at the base; seeds provided with an eccentric, basal wing.................................PLUMERIA

Inflorescence rather regularly thyrsiform, the secondary branches alternate and relatively distant; bracts large and showy, petalaceous or foliaceous, caducous, subtended by numerous minute, pectinate, adaxial glands at the base; calyx-lobes very irregular in size, gradually acuminate and not glandular at the tip, or the calyx not manifest; ventral loculi of the anthers not protuberant; seeds provided with a broad, more or less concentric, papery wing .... HIMATANTHUS

Of the characters mentioned above, perhaps the only one which requires special discussion is the glandular character of the calyx of *Plumeria,* the calyx-lobes being found with the naked eye to be somewhat discolored and "sticky" at the tip. When examined in section by means of the compound microscope, the epidermal cells of the calyx tip are found to be elongated horizontally, and to have other histological and cytological characteristics of secretory tissues, such as those of the calycine "squamellae" of numerous other Apocynaceae, which are lacking in both *Plumeria* and *Himatanthus.*

At this juncture it may not be amiss to accentuate again that the distributions of *Plumeria* and *Himatanthus* are not strictly separated by arbitrary boundaries, as both occur somewhat sparingly in eastern Panama, and in Colombia, Venezuela, and the Guianas. However, the distribution of the former reaches its climax in Central America and the Greater Antilles, whilst the latter is particularly characteristic of the Amazon valley. Plants of undoubted northern affinities have been found elsewhere in South America and have been proposed as distinct species by Ruiz & Pavon, Mueller-Argoviensis, and others. But the same is true for as widely separated localities as Madagascar, the Philippine Islands, and southeastern Asia, where from a superficial observation Plumerias may appear to be spontaneous, and from whence novelties were described occasionally before it was recognized that the plants undoubtedly had escaped from early cultivation by the colonial Spanish, English, and French. At this time it may not be too late to indicate Central America as the probable provenience of these widely cultivated ornamental trees. The South American species *(Himatanthus)* have been cultivated much less than those of the North *(Plumeria),* possibly since, although the inflores-

cence is as copious and the flowers as large, there is a marked tendency for fewer flowers to be open at one time because of the greater structural regularity of the inflorescence.

Although our knowledge of the botany of tropical America still is deplorably scant, it appears possible upon our present herbarium representation to offer a tentative revision of the species of both *Plumeria* and *Himatanthus* incidental to a reformation of the genera. Even though limited in scope, such an evaluation should be of considerable aid to those who find the attenuated specific distinctions of Mueller, Britton, Urban, and others of little practical value in the classification of their specimens of the inclusive genus *Plumeria.*

I am very grateful to have had the opportunity of examining specimens of *Plumeria* and *Himatanthus* from several of the more important American and European herbaria. Since these genera are very poorly known, particularly in South America, exsiccatae have been freely cited by means of the following symbols: Botanischer Garten zu Berlin-Dahlem (B); Herbier Boissier (BB) and Herbier Delessert (D), Conservatoire Botanique, Geneva; Field Museum of Natural History, Chicago (FM); Gray Herbarium of Harvard University, Cambridge, Mass. (G); Botanisches Museum, Munich (M); Missouri Botanical Garden, St. Louis (MBG); Muséum National de l'Histoire Naturelle, Paris (MP); New York Botanical Garden, New York City (NY); Naturhistoriska Riksmuseum, Stockholm (S); Botanisch Museum, Rijks Universiteit, Utrecht (U); United States National Herbarium, Washington (US); Naturhistorisches Museum, Vienna (V). I wish to express my appreciation to the various curators and directors, and particularly to Dr. L. Diels and Dr. Fr. Markgraf, who located the type specimen of *Himatanthus* in the herbarium of Willdenow, and sent it to me for examination.

HIMATANTHUS Willd. char. emend.

Himatanthus Willd. ex R. & S. Syst. **5**: 221. 1819.

Lactescent trees of small or medium stature. Stem essentially terete, usually with a rather broad pith becoming fistu-

lose, with fairly heavy wood, and rimose, flaky periderm scarred by the spiral cicatrices of fallen foliage; branches alternate to dichotomous. Leaves alternate, petiolate to sessile, penninerved, eglandular. Inflorescence terminal or pseudolateral, rather regularly thyrsiform, the secondary peduncles alternate and usually rather distant, bearing several to numerous handsome, white flowers, very conspicuously bracteate. Bracts large and showy, more or less petalaceous or foliaceous, caducous, bearing within numerous minute, persistent, pectinate, interpetiolar glands. Calyx essentially obsolete or consisting of 1–5 acute to acuminate, eglandular lobes of very unequal length and inconstant size, cleft nearly to the receptacle and never closely imbricated, without squamellae. Corolla salverform, the tube essentially straight, inappendiculate within, the limb actinomorphic, 5-parted, sinistrorsely convolute. Stamens 5, the anthers separate and free from the stigma, consisting of 2 wholly fertile, uniform thecae without protuberant bases; pollen granular. Carpels 2, strikingly subinferior, united at the apex by a common fusiform, 2-apiculate stigma; ovules many, several-seriate, borne upon an axile placenta which becomes corky and deciduous in the fruit. Nectaries absent. Follicles 2, apocarpous, usually somewhat compressed, dehiscing along the ventral suture, containing many dry, compressed, more or less concentrically winged seeds.

Type species: *Himatanthus articulata* (Vahl) Woodson, comb. nov. (*Plumeria articulata* Vahl, Eclog. Amer. 2: 20. 1798; *Himatanthus rigida* Willd. ex R. & S. Syst. 5: 221. 1819).

Trees of *Himatanthus* apparently vary considerably in height, collectors of flowering material reporting approximate dimensions from one to thirty meters. The boles are predominantly quite slender, however, and even the tallest specimens are said to attain but approximately 30 cm. near the base. The leaves vary considerably in size, ranging from 4 to 20 cm. in length within single species. As in the closely related genus *Plumeria,* the leaves apparently persist for only a relatively short time and occur chiefly toward the ends of the smaller branches. Unlike *Plumeria,* however, flowering specimens apparently never are found in a completely leafless condition.

The flowers are showy, invariably white in color, and of a rather waxy texture, as in *Plumeria.* Collectors report them to be pleasingly fragrant. The complete length of the corolla varies in general from 3 to 6 cm., the obovate to obovate-oblong lobes about equalling the length of the tube, which is predominantly 0.2 cm. in diameter at the base. The flowers are borne in a cincinnous manner at the swollen nodes of the compound inflorescence. At each node, ensheathing the secondary peduncle and the paired flowers, are borne two petalaceous, rather canaliculate, caducous bracts, which measure from 1 to 2.5 cm. in length, somewhat recalling the glumes of a grass spikelet, greatly enlarged.

The follicles are relatively broad, acuminate, and slightly, if at all, compressed. The length varies from as little as 6 cm. in *H. attenuata* to a maximum of 24 cm. in *H. articulata.* The seeds are greatly compressed, and are provided with a rather broad, more or less concentric, papery wing, much as those of the genus *Aspidosperma.* The seeds, which have a persistent endosperm (unlike those of *Aspidosperma),* are peltately affixed to the placenta, and are predominantly broadly ovate, varying from 2 to 8 cm. in length. At dehiscence of the follicle the placenta is shed with the seeds, and is found to be a most peculiar, corky, fusiform structure, as in *Plumeria,* ranging from 3 to 20 cm. in length, and from 0.7- to 1.5 cm. in diameter.

The large-bracted species of the inclusive genus *Plumeria,* which are now being relegated to *Himatanthus,* are an extremely difficult subject for taxonomic study at the present time. Apparently never abundant in the forest vegetation, but relatively few exsiccatae are available for study. The paucity of specimens obviously renders an evaluation of interspecific variability quite fallible: consequently the formulation of detailed descriptions in a study of this nature is impractical.

Under such conditions, the apparent absence of well-defined taxonomic criteria is particularly exasperating. Flower structure, including the anthers and stigmata, appears to offer no distinctions of merit which can be tested adequately from the present representation; and fruiting material is scant or lacking for the species. The calyx, which has been relied upon for

criteria by such investigators as Mueller-Argoviensis and Markgraf, is particularly inconstant.

The best indicators of relationship would appear to be the venation, texture, and shape of the leaves, notwithstanding the opinions of K. Schumann (in Engl. & Prantl, Nat. Pflanzenfam. 4^2: 136. 1895) and Markgraf (in Pulle, Fl. Surinam 4: 17. 1932). Although leaf characters have been employed almost exclusively in this purely tentative treatment, it probably is inevitable that their use may have to be modified greatly as additional material, so greatly needed, finds its way into our collections. It should be borne in mind by those who attempt to use the following key that it is offered quite provisionally, and is designed merely as a basis for the re-establishment of the genus *Himatanthus*.

KEY TO THE SPECIES

a. Netted tertiary venation of leaves fine and dense, conspicuously verrucose in virtually its entirety upon the upper surface in desiccation.

b. Leaves lustrous, particularly above, the secondary venation relatively distant and broadly arcuate, the marginal vein rather poorly developed, deeply and irregularly sinuous.......................... *1. H. articulata*

bb. Leaves usually opaque, the secondary venation relatively close and essentially rectilinear, the marginal vein well developed and only very slightly sinuous.................................... *2. H. attenuata*

aa. Netted tertiary venation of leaves fairly irregular and distant, more or less obscure upon the upper surface in desiccation.

b. Leaves manifestly petiolate, invariably glabrous.

c. Leaves firmly membranaceous to subcoriaceous, obovate-elliptic to oblanceolate-oblong.

d. Leaves broadest somewhat above the middle, tapering rather gradually, or obtuse; inflorescence corymbose or subcorymbose...... .... *3. H. Sucuuba*

dd. Leaves broadest near the tip, tapering rather abruptly, or broadly obtuse to rounded; inflorescence pyramidal.

e. Leaves more or less broadly obovate-elliptic, three to four times as long as broad, the tip obtuse or rounded to very shortly and obtusely acuminate.......................... *4. H. phagedaenica*

ee. Leaves oblanceolate-oblong, four to seven times as long as broad, the tip acutely subcaudate-acuminate to obtuse.... *5. H. lancifolia*

cc. Leaves rather heavily coriaceous, broadly obovate to obovate-oblong .... *6. H. bracteata*

bb. Leaves sessile to subsessile, occasionally more or less pubescent......... .... *7. H. obovata*

1. HIMATANTHUS **articulata** (Vahl) Woodson, comb. nov.
Plumeria articulata Vahl, Eclog. Amer. 2: 20. 1798; Mgf. in Pulle, Fl. Surinam **4**: 16. 1932.
Himatanthus rigida Willd. ex R. & S. Syst. **5**: 221. 1819.
Plumeria drastica Mart. in Spix & Mart. Reise Bras. **2**: 547. 1828; A. DC. in DC. Prodr. **8**: 393. 1844; Muell.-Arg. in Mart. Fl. Bras. **6**^{1}: 38. 1860.
Plumeria fallax Muell.-Arg. in Mart. Fl. Bras. **6**^{1}: 38. 1860.
Plumeria microcalyx Standl. Field Mus. Publ. Bot. **4**: 254. 1929.

PANAMA: SAN BLAS: Permé, April 3–10, 1928, *Cooper 642* (FM, NY, US); DARIEN: Cana and vicinity, alt. 2000–6500 ft., April 17–June 8, *Williams 823* (NY).

VENEZUELA: BOLIVAR: Ciudad Bolivar and vicinity, Febr.–March, 1921, *Bailey & Bailey 1384* (MBG); Catalina, May, 1896 *Rusby & Squires 303* (B, D, G, M, MBG, US); data incomplete, 1901–1902, *Passarge & Selwyn 835* (B).

BRITISH GUIANA: Wakefeon Creek, Pomeroon River, Oct., 1899, *Jenman 7968* (B); data incomplete, *Schomburgk 403* (B).

DUTCH GUIANA: Sandrij I., Nov. 14–25, 1934, *Archer 2793* (MBG); Sectie O (Waldreservat), date lacking, *Boschwezen 1394* (B); Brownsberg, Sept. 11, 1917, *Boschwezen 3257* (Bx, U); Boschreserve, Kaboerie, Aug. 27, 1920, *Boschwezen 4956* (B, U); data incomplete, *Hostmann (& Kappler) 1311* (D, MP, S, U, V).

FRENCH GUIANA: Reservoir Hill, Matabon, vicinity of Cayenne, July 12, 1921, *Broadway 779* (G, US); Mana, 1896, *Sagot 894* (BB, MP, S); data incomplete, 1802, *Gabriel s.n.* (D, MP).

BRAZIL: AMAZONAS: Rio Quino Igarape, Sept., 1927, *Luetzelburg 21477* (M); Igarape, Sept., 1927, *Luetzelburg 21547* (M); bei S. Marcos, Rio Branco, Jan., 1909, *Ule 7829* (B); Maues, Dec., 1928, *Jard. Bot. Rio Jan. 21609* (B, S, US); PARA: in colle Serra da Tabatinga prope Arrayollos inter Almerim et fl. Jary, April 29, 1923, *Ducke 17473* (S); Bragança, Jan. 10, 1923, *Ducke 17475* (B); Juruty Velho, Dec. 19, 1926, *Ducke 21558* (B); Santarem, July 3, 1926, *Ducke 21596* (B, US); Rio Trombetas infer., silva ad ripas inundatas Lago Salgado, Nov. 27, 1910, *Ducke 21785* (B); campos do Ariramba in reg. fl. Trombetas, Dec. 13, 1910, *Ducke 21790* (B); Aramanahy, Jan., 1932, *Monteiro da Costa 236* (MBG); Ilha do Mosqueiro, near Para, Nov. 3–9, 1929, *Killip & Smith 30660* (MBG, US); sylvis ad Para, May, year lacking, *Martius s.n.* (M); in vicinibus Santarem, Nov.–Mart., 1849–50, *Spruce 231* (B, G, M); Municipality of São Paulo de Olivença, basin of creek Belem, Oct. 26–Dec. 11, 1936, *Krukoff 8786* (NY); MARANHAO: Maracassume River region, July 12, 1932, *Froes 1777* (D, MBG, S); Insula Mangunca, prope Cururupu, Aug., 1914, *Lisboa 4785* (B, BB, S, US); ALAGOAS: Maceio-Penedo, alt. 100 m., March, 1932, *Werdermann 3020* (B); BAHIA: Serra do Sao Ignacio, Febr., 1907, *Ule 7205* (B); Rio Preto, date lacking, *Zehntner 2082* (M); GOYAZ: Cam-

pinas, bei Duro, 1913, *Luetzelburg 639* (M); DATA INCOMPLETE: "Habitat in interioribus prov. Minarum et Bahiensis ad Caitete, Malhada, Salgado aliisque locis," date lacking, *Martius s.n.* (M).

Occasionally the leaves of this species approach the subsessile condition of those of *H. obovata,* from which they may be distinguished, however, by the lustrous upper surface with its characteristically verrucose venation.

H. articulata forms rather slender trees 5 to 25 m. tall. Popular names are reported as "Santo Maria" (Bailey & Bailey), "Sucuúba" (Ducke, Huber), and "Jauahuba" (Lisboa).

2. HIMATANTHUS **attenuata** (Benth.) Woodson, comb. nov.

Plumeria attenuata Benth. in Hook. Jour. Bot. **3**: 245. 1841; A. DC. in DC. Prodr. **8**: 393. 1844; Muell.-Arg. in Mart. Fl. Bras. **6**^{1}: 42. 1860.

Plumeria angustiflora Spruce, ex Muell.-Arg. in Mart. Fl. Bras. **6**^{1}: 42. 1860, nom. nud. in synon.

Plumeria attenuata Benth. β. *obtusifolia* Muell.-Arg. in Mart. Fl. Bras. **6**^{1}: 42. 1860.

Plumeria attenuata Benth. γ. *Malongo* Muell.-Arg. in Mart. Fl. Bras. **6**^{1}: 42. 1860.

Plumeria Malongo Spruce, ex Muell.-Arg. Fl. Bras. **6**^{1}: 42. 1860, nom. nud. in synon.

BRAZIL: AMAZONAS: Ilha de Jerusalem, Rio Negro, near mouth of Rio Cauabury, Dec. 18, 1930, *Holt & Blake 561* (MBG, S, US); along Rio Negro, above Manaos, alt. 25 m., Oct. 14, 1929, *Killip & Smith 30029* (MBG, US); Uypiranga prope Manaos, Dec. 21, 1923, *Kuhlmann 21864* (B); in sylvis japurensibus, Dec.–Jan., year lacking, *Martius s.n.* (M); Ufer am Igarape, Manaos, Aug. 28, 1922, *Raymundo 22088* (M); Rio Trombetas, Dec., 1849, *Spruce 539* (MP); in vicinibus Barra, Dec.–Mart., 1850–51, *Spruce 1004* (B, D, G, M, MP, ISOTYPES); prope Panure, Rio Uaupes, Dec., 1852, *Spruce 2764* (Bx, MP); Cachoeira Grande, bei Manaos, Aug., 1910, *Ule 8951* (B, D); Maues, ad ripas fluminis, Dec., 1928, *Jard. Bot. Rio Jan. 21608* (B, BB, S, US); PARA: Lago de Faro, ripis inundatis, Jan. 4, 1920, *Ducke 11401* (B); ad ripas fluminis das Trombetas et lacus Quiriquiry, Dec., 1849, *Spruce 230* (M); ESPIRITO SANTO: data incomplete, *Glaziou 9938* (MP).

Popular names of *H. attenuata* are reported as "Malongo" (Spruce) and "Sucuuba-rana" (Ducke). This species consists of slender trees 6–10 m. in height.

3. Himatanthus **Sucuuba** (Spruce) Woodson, comb. nov.
Plumeria Sucuuba Spruce, ex Muell.-Arg. in Mart. Fl. Bras. **6**[1]: 40. 1860.
Plumeria floribunda Muell.-Arg. in Mart. Fl. Bras. **6**[1]: 40. 1860.
Plumeria tarapotensis K. Sch. ex Mgf. Notizblatt **11**: 339. 1932.

Peru: junin: Perene, Chanchamayo, Paucartambo, 1920, *Nordenskjold & Rospigliosi s.n.* (B); in Chanchamayo-Thal, Prov. Tarma, Dec., 1902, *Weberbauer 1927* (B); loreto: Yurimaguas, lower Rio Huallaga, alt. 135 m., Aug. 22–Sept. 9, 1929, *Killip & Smith 27606* (MBG, US); Mishuyacu, near Iquitos, alt. 100 m., Oct.–Nov., 1929, *Klug 230* (US); Tocache, Huallaga, 1830, *Poeppig s.n.* (V); Chicoplaya, date lacking, *Tafalla s.n.* (B); Stromgebiet des Ucayali von 10° bis zur Mündung, Sept. 20, 1923, *Tessmann 3205* (B, D); Stromgebiet des Maranon von Iquitos aufwärts bis zur Santiago-Mündung am Pongo de Manseriche, Aug. 29, 1924, *Tessmann 3903* (B, D); Yurimaguas, March 18, 1926, *Tessmann 5512* (B, S); Tarapoto, Oct., 1902, *Ule 6473* (B, D); Rioja (westl. von Moyobamba), Sept. 8, 1904, *Weberbauer 4701* (B, D); lower Rio Huallaga, alt. 155–210 m., Oct.–Nov., 1929, *Williams 3988* (US); san martin: alto Rio Huallaga, Dec., 1929, *Williams 6559* (MBG).

Bolivia: beni: Rurrenabaque, alt. 1000 ft., June 1–7, 1921, *Rusby 1558* (US); la paz: Tipuani-Guanai, Dec., 1892, *Bang 1679* (B, BB, D, G, M, MBG, NY, US); Tumupasa, Dec. 10, 1901, *Williams 401* (US); santa cruz: Montes de Buenavista, Prov. Sara, April 23, 1916, *Steinbach 2048* (B); Rio Surutu, Prov. Sara, Dec. 27, 1924, *Steinbach 6827* (B, D, MBG, S).

Brazil: amazonas: Manaos, Dec. 8, 1927, *Ducke 21606* (B); Rio Jauary, Oct. 20, 1927, *Ducke 21607* (B, US); Municipality Humayta, on plateau between Rio Livramento and Rio Ipixuna, Nov. 7–18, 1934, *Krukoff 7195* (MBG); near mouth of Rio Embira (tributary of Rio Tarauca), June 13, 1933, *Krukoff 4787* (FM, NY); Municipality São Paulo de Olivença, June, 1936, *Krukoff 7846* (NY); near Palmares, Municipality São Paulo de Olivença, Sept. 11–Oct. 26, 1936, *Krukoff 8413* (NY); basin of creek Belem, Municipality of São Paulo de Olivença, Oct. 26–Dec. 11, 1936, *Krukoff 8926* (NY); Ega, date lacking, *Martius s.n.* (M); prope Barra, Oct., 1851, *Spruce 1848* (B, Bx, type, G, MP); Panure, Maupes, date lacking, *Spruce 2794* (MP); Manaos, Jan., 1901, *Ule 5385* (B, D); matto grosso: near Tabajara, upper Machado River region, Nov., Dec., 1931, *Krukoff 1463* (B, D); para: Rio Erepeeuru, affl. Trombetas, ad ripas cataractae Cachoeira Troneo, Oct. 20, 1913, *Ducke 21783* (B); acre: near mouth of Rio Macauhan (tributary of Rio Yaco), Aug. 29, 1933, *Krukoff 5689* (FM, NY).

Trees of this species are said to attain a height of 30 m. (Krukoff), although other collectors report flowering specimens of only 2 m. Popular names are reported as "Sucuuba"

(Spruce, Krukoff), "Cipoal" (Krukoff), "Leche-leche" (Steinbach), and "Bellaku-Kaspi" (Tessmann).

4. HIMATANTHUS **phagedaenica** (Mart.) Woodson, comb. nov.

Plumeria phagedaenica Mart. in Spix & Mart. Reise Bras. **3**: 1128. 1831; A. DC. in DC. Prodr. **8**: 394. 1844; Muell.-Arg. in Mart. Fl. Bras. **6**^{1}: 37. 1860; K. Sch. in Engl. & Prantl, Nat. Pflanzenfam. **4**^{2}: 136. 1895.

Plumeria ambigua Muell.-Arg. in Mart. Fl. Bras. **6**^{1}: 37. 1860.

Plumeria Martii Muell.-Arg. in Mart. Fl. Bras. **6**^{1}: 37. 1860.

Plumeria speciosa Muell.-Arg. in Mart. Fl. Bras. **6**^{1}: 36. 1860; K. Sch. in Engl. & Prantl, Nat. Pflanzenfam. **4**^{2}: 136. 1895.

Plumeria floribunda Muell.-Arg. β. *crassipes* Muell.-Arg. in Mart. Fl. Bras. **6**^{1}: 40. 1860.

Plumeria floribunda Muell.-Arg. γ. *calycina* Muell.-Arg. in Mart. Fl. Bras. **6**^{1}: 41. 1860.

Plumeria floribunda Muell.-Arg. δ. *acutifolia* Muell.-Arg. in Mart. Fl. Bras. **6**^{1}: 41. 1860.

Plumeria fallax Muell.-Arg. in Mart. Fl. Bras. **6**^{1}: 38. 1860, as to specimens cited, in part.

Plumeria lancifolia Muell.-Arg. β. *major* Muell.-Arg. in Mart. Fl. Bras. **6**^{1}: 41. 1860.

Plumeria lancifolia Muell.-Arg. γ. *microphylla* Muell.-Arg. in Mart. Fl. Bras. **6**^{1}: 41. 1860.

BRAZIL: AMAZONAS: sylvis ad Rio Cachoeira prope Barra do Rio Negro, Oct., year lacking, *Martius 2778* (M, TYPE); PERNAMBUCO: Tapera, Jan., 1929, *Pickel 1882* (B); Cajueiro nordwestl. Recife, c. 100 m. alt., Febr., 1932, *Werdermann 2785* (B); data incomplete, *Ridley Lea & Ramage s.n.* (B, S); BAHIA: sylvis Catingas ad Feira de Conceiçao, Febr.–Mart., year lacking, *Martius 2252* (M); Vittoria-Bahia, date lacking, *Sello s.n.* (B); data incomplete, *Blanchet 223* (D, MP); *Blanchet 929* (D); *Lhotsky 4* (B); MINAS GERAES: data incomplete, 1831, *Ackermann s.n.* (Bx); RIO DE JANEIRO: data incomplete, *Glaziou 11175* (B); DATA INCOMPLETE: *Ackermann s.n.* (B); *Link s.n.* (B); *Pohl s.n.* (Bx); *Sello 32* (Bx); *Sello s.n.* (B).

Reported by collectors to form high trees.

5. Himatanthus **lancifolia** (Muell.-Arg.) Woodson, comb. nov.

Plumeria lancifolia Muell.-Arg. in Mart. Fl. Bras. **6**[1]: 41. 1860.

Plumeria lancifolia Muell.-Arg. β. *major* Muell.-Arg. in Mart. Fl. Bras. 6[1]: 41. 1860, as to specimens cited, in part.

Brazil: espirito santo: Rio Doce, Febr., 1907, *Luetzelburg 7222* (M); minas geraes: Serra dos Vertentes, près Oliveira, Aug. 22, 1882, *Glaziou 14069* (B, MP); s.e. corner of Agricultural College grounds, Viçosa, alt. 590 m., Dec. 19, 1929, *Mexia 4136* (MBG); hill northwest of director's house, alt. 675 m., Dec. 15, 1930, *Mexia 5408* (MBG); data incomplete, *St.-Hilaire 42* (MP); rio de janeiro: Corvocado et Pain de S., 1858, *Guillos s.n.* (MP); Vista Chineza, March, 1917, *Hoehne 24608* (B); Canta Gallo, 1859, *Peckolt 58* (Bx, type); sylvarum margines per Serra do Mar, date lacking, *Martius s.n.* (M); data incomplete, *Glaziou 640* (Bx); *Mosen 2533* (S); *Widgren 828* (S, US); data incomplete: *Freyreiss s.n.* (S); *Glaziou 20409* (B); *Pohl 1837* (Bx); *Sello 1273* (B).

I suspect that this species may ultimately prove to be but a variety of *H. phagedaenica.*

6. Himatanthus **bracteata** (A. DC.) Woodson, comb. nov.

Plumeria bracteata A. DC. in Prodr. **8**: 394. 1844; Muell.-Arg. in Mart. Fl. Bras. **6**[1]: 36. *pl. 11, fig. 2.* 1860.

Plumeria revoluta Huber, Bull. Soc. Bot. Genève II. **6**: 200. 1915.

British Guiana: Malali, Demerara River, Oct. 30–Nov. 5, 1922, *Cruz 2743* (G); Barima River, Northwest District, March 19–22, 1923, *Cruz 3361* (G); dry sandhills east of Rockstone, July 22–30, 1921, *Gleason 777* (G).

Dutch Guiana: savannah near Brownsberg, Nov. 13, 1933, *Lanjouw 1252* (B).

Brazil: amazonas: infra cataractas Camanaos, Nov. 22, 1929, *Ducke 22404* (B); Ufer des Igarape, Oct. 6, 1928, *Luetzelburg 22351* (M); Igapo, Rio Negro, Oct. 9, 1928, *Luetzelburg 22903* (M); Fl. Uaupes, Nov., 1852, *Spruce 2721* (MP); para: inter Almeirim et Prainha, Oct. 6, 1919, *Ducke 11399* (B); Pampinas de l'Achipica, Rio Trombetas, Oct. 15, 1913, *Ducke 14987* (US); pernambuco: data incomplete, *Paulay s.n.* (V); bahia: data incomplete, *Blanchet 13* (MP, type).

I suspect that *H. bracteata* and *H. articulata* hybridize in the Guianas and northeastern Brazil. Several specimens suggesting this possibility bear leaves with the texture of *H. bracteata* but with the verrucose venation of *H. articulata,* and have been assigned, consequently, to the latter species in citation.

7. HIMATANTHUS **obovata** (Muell.-Arg.) Woodson, comb. nov.

Plumeria obovata Muell.-Arg. in Mart. Fl. Bras. 6[1]: 40. 1860.

var. **typica.**

Plumeria Warmingii Muell.-Arg. in Warming, Kjoeb. Vidensk. Meddel. p. 99. 1869.

Plumeria oligoneura Malme, Arkiv f. Bot. **21A**[6]: 6. 1927 (see note below).

Plants wholly glabrous throughout.

BRAZIL: BAHIA: data incomplete, *Luschnath 190* (B); GOYAZ: data incomplete, *Glaziou 21736, in part* (B); MATTO GROSSO: Santa Ana da Chapada, Sept. 24, 1902, *Malme 2375* (S); MINAS GERAES: inter Uberava et Melancias, Nov. 29, 1848, *Regnell III 867, in part* (S, US); Lagoa Santa, 1870, *Warming s.n.* (D); data incomplete, *Claussen 330* (G, S); *St.-Hilaire 576* (MP); SAO PAULO: inter Canna Verde et S. Joao de Jaguary, May 5–8, 1848, *Regnell III 867, in part* (S); inter Franca et Uberava, July, 1848, *Regnell III 867, in part* (S); Cajuru, March, 1857, *Regnell III 867, in part* (S); DATA INCOMPLETE: *Glaziou 19628* (B, MP); *Pohl s.n.* (Bx); "S. Luzia Corumba, Villa Boa," *Pohl s.n.* (M); *Schwake 8165* (B); *Sello 1643* (B, Bx); "Bresil Central," *Weddell 2508* (MP).

BOLIVIA: data incomplete, *d'Orbigny s.n.* (MP).

var. **puberula** (Muell.-Arg.) Woodson, comb. nov.

Plumeria puberula Muell.-Arg. in Mart. Fl. Bras. 6[1]: 39. 1860.

Plumeria velutina Muell.-Arg. in Mart. Fl. Bras. 6[1]: 38. 1860.

Plumeria Hilariana Muell.-Arg. in Mart. Fl. Bras. 6[1]: 39. 1860.

Plumieria latifolia Pilger, in Engl. Bot. Jahrb. **30**: 183. 1901.

Leaves and young stem more or less densely velutinous-puberulent to glabrate.

BRAZIL: GOYAZ: central plateau, 1894–95, *Glaziou 21736, in part* (D); MATTO GROSSO: Cuyaba, Nov., 1893, *Malme 1120* (S); same place, July 4, 1902, *Malme s.n.* (S); Serradao bei Cuyaba, Febr. 15–20, 1899, *Pilger 198* (B); MINAS GERAES: data incomplete, 1816–1821, *St.-Hilaire s.n.* (MP).

The type specimen of *Plumeria oligoneura* Malme (*Malme 2375,* in herb. Stockholm) suggests hybridity with *H. Sucuuba,* since the leaves have short petioles, venation much as in *H.*

Sucuuba, and general outline intermediate between *Sucuuba* and *obovata.* The specimen certainly is not worthy of specific rank upon the basis of our present knowledge of the genus.

PLUMERIA L. char. emend.

Plumeria [Tourn.] L. Sp. Pl. ed. 1. **1**: 209. 1753; Gen. Pl. ed. 5. 99. 1754; A. DC. in DC. Prodr. **8**: 389. 1844, in part; K. Sch. in Engl. & Prantl, Nat. Pflanzenfam. **4²**: 136. 1895, in part; Britton, Bull. Torrey Bot. Club **42**: 503. 1915.

Lactescent trees of small or medium stature. Stems terete or essentially so, usually with a broad pith becoming fistulose, with light wood and rimose, corky periderm scarred by the spiral cicatrices of fallen leaves; branches dichotomous to alternate. Leaves alternate, petiolate to sessile or subsessile, penninerved, eglandular. Inflorescence terminal or pseudolateral, fastigiately thyrsiform, usually greatly congested, bearing few to numerous handsome flowers, very inconspicuously bracteate. Bracts small, scarious, caducous. Calyx 5-parted, the lobes equal to subequal, cleft nearly to the receptacle, closely imbricated, glandular at the tips, but without squamellae at the base within. Corolla salverform, the tube essentially straight, exappendiculate within, the limb actinomorphic, 5-parted, sinistrorsely convolute. Stamens 5, the anthers separate and free from the stigma, consisting of 2 wholly fertile, basally protuberant thecae; pollen granular. Carpels 2, strikingly subinferior, united at the apex by a common, fusiform, 2-apiculate stigma; ovules many, several-seriate, borne upon an axile placenta which becomes corky and deciduous in the fruit. Nectaries absent. Follicles 2, apocarpous, stout, terete or essentially so, dehiscing along the ventral suture, containing many dry, compressed, basally winged seeds.

Type species: *Plumeria rubra* L. Sp. Pl. ed. 1. **1**: 209. 1753.

Founded as a tribute to Charles Plumier, the pioneer systematist of the tropical New World flora, the genus was spelled *Plumeria* by both Tournefort and Linnaeus, as well as by such subsequent authors as A. de Candolle, Bentham, and Baillon. The spelling *Plumiera* also was used by Linnaeus,

however, in the 'Philosophia' (31. 1751), and followed by Adanson, C. Kuntze, and K. Schumann, influenced doubtless by Burmann's Latinization of the personal name of the illustrous Minim as "Plumierius." A still further change to *Plumieria* was made by Scopoli (Introd. 155. 1777). Use of all three variants has been widespread, even by a single author. More recently Urban (in Fedde, Repert. Spec. Nov. **14**: 341. 1916) has come to the defense of the original spelling *Plumeria*, pointing out that it has both priority and the sanction of correct etymology, since the correct Latinization of Plumier's name should be "Plumerius."

An evaluation of the species of *Plumeria* by students unable to gain an extensive knowledge of the plants in the field, among whom the present writer must be counted, is attended by several difficulties. The first of these is the paucity of morphological characters in the flowers and fruits, the relatively few of which have been either unknown to most authors, or ignored by them.

The color of the corolla apparently is always white "with a yellow eye" in the species indigenous to the Antilles and northern South America. But the inclusive *P. rubra* L. (as interpreted in this revision), which is supposedly the only species indigenous to Central America, demonstrates a bewildering variety of flower color ranging from pure white to uniform deep yellow or rose, together with various combinations of shades. This diversity has prompted specific segregation to a surprising extent, since the plants have been admired so greatly and are so frequent in cultivation. To the present writer, however, color variations in *P. rubra* are certainly not specific, because of the lack of accompanying characters; and such segregation is rendered extremely impractical as well by the loss or change of flower color in desiccation. In the revision which follows a few outstanding color variations are accorded formal rank for the use of those who desire some distinction in the matter.

In the absence of other morphological characters, several authors, notably Britton and Urban, have attempted extensive segregation of the Plumerias of the Antilles upon the bases of

leaf shape, size, and indument, which certainly are extremely diversified within certain limits. A difficulty encountered in such characters is that the foliage is very deciduous, rendering herbarium specimens imperfect in a surprising number of cases. Then too, Plumerias are very prone to bloom in a leafless condition.

There can be little doubt that the leaf outline of the Antillean species of *Plumeria* is much more variable than the describers of some species apparently have realized. If one arranges in a single series a suite of leaves each of which has been taken from type specimens of as many species from the *P. obtusa* L. complex described by Grisebach, Urban, Britton, and others, the difficulty of segregation upon such characters at once becomes apparent. Hence slight variations in leaf outline have been discounted greatly in the present revision. Since the presence or absence of indument is a character easily perceived and in favor with those who prefer their taxonomic entities "cut fine," *P. obtusa* has been divided into a glabrous variety and one which is more or less pubescent upon the lower leaf surface, but this also with reluctance.

Although known under a variety of aboriginal names, the most widespread popular name for the cultivated Plumerias in use by Europeans is "Frangipani" or "Frangipanier." Sir J. J. Smith (in Rees, 'Cyclopaedia,' 1810) discusses the provenience of this name as follows: "The French name of this genus, *Frangipanier,* is rather remarkable. It is said to allude to its fragrance, *Frangipani* being a sort of perfume so-called in France from its inventor, an Italian, of the Frangipani family, so conspicuous in the Roman disturbances of the twelfth century." The odor was described by Jacquin as being "perhaps the sweetest of any plant living," well-merited praise, although individuals occasionally are encountered which are practically scentless. The fragrance, as well as the abundance of waxy, beautifully tinted flowers, apparently caused the Plumerias to be prized by the Indians long before the advent of the Spaniards, and garlands are still used in tropical America as nosegays and head-dresses and to decorate altars. Transplanted by admiring Europeans, *P. rubra* now is found

in cultivation throughout the world's tropics, vying in popularity even with the ubiquitous *Nerium Oleander*.

KEY TO THE SPECIES

a. Corolla subinfundibuliform, the tube gradually dilating above the insertion of the stamens to an orifice about twice the diameter of the base.
 b. Leaves definitely petiolate, obovate-elliptic to oblanceolate, not pandurate or cochleate; corolla-lobes fully contorted in the bud, strikingly spiral in aestivation; Colombia; British Guiana..................*1. P. inodora*
 bb. Leaves subsessile, obovate-oblong, more or less pandurate or cochleate; corolla-lobes about half convolute in the bud, longitudinal in aestivation, or scarcely spiral; Colombia; Venezuela; Martinique....*2. P. pudica*
aa. Corolla strictly salverform, the orifice of the tube about equalling the diameter of the base, or slightly narrower.
 b. Secondary venation of leaves entering the midrib at a more or less conspicuously decurrent, narrowly acute angle, at least in part; aestivation of corolla-lobes conspicuously spiral.
  c. Leaves conspicuously petiolate, subcoriaceous, with a conspicuous marginal vein, secondary and tertiary venation more or less immersed upon the upper surface; flowers white, yellow, rose, or particolored; Central America generally, frequently cultivated in the Antilles, South America, and elsewhere in the tropics and subtropics...*3. P. rubra*
  cc. Leaves subsessile, membranaceous, without a well-developed marginal vein, secondary and tertiary venation extremely pronounced upon both surfaces; flowers white "with a yellow eye"; Hispaniola.... ....*7. P. subsessilis*
 bb. Secondary venation of leaves entering the midrib directly; aestivation of corolla-lobes longitudinal, or scarcely spiral.
  c. Leaves obovate to obovate-oblong, rounded, emarginate, or very broadly obtuse at the apex, rarely very shortly and abruptly acuminate-submucronulate, coriaceous to subcoriaceous, rarely firmly membranaceous, secondary veins anastomosing distally to form a well-developed marginal vein; Bahama Islands; Cuba; Hispaniola; Jamaica; Puerto Rico; locally in Yucatan and British Honduras.... ....*4. P. obtusa*
  cc. Leaves lanceolate or oblong-lanceolate to subfiliform, narrowly and gradually acute to acuminate at the apex, firmly membranaceous to subcoriaceous, secondary veins anastomosing distally but not forming a well-developed marginal vein.
   d. Leaves linear-lanceolate to subfiliform, 0.1–1.0 cm. broad, firmly membranaceous, wholly glabrous; Cuba................*5. P. filifolia*
   dd. Leaves lanceolate to oblong-lanceolate, 1–4 cm. broad, subcoriaceous, the margins very characteristically "puckered-revolute" in desiccation, usually densely pubescent beneath; Puerto Rico; Virgin Islands; Lesser Antilles...............................*6. P. alba*

(Attention is called to the discussion of hybridization, as an aid to the determination of anomalous specimens, particularly those of Hispaniola.)

1. PLUMERIA INODORA Jacq. Select. Stirp. Amer. Hist. **1**: 36. 1763.

Plumeria alba L. var. β. *fragrans* HBK. Nov. Gen. **3**: 230. 1819.

Plumiera alba L. var. *fragrantissima* G. Don, Gen. Hist. **4**: 94. 1838.

Plumiera alba L. var. *inodora* (Jacq.) G. Don, Gen. Hist. **4**: 94. 1838.

COLOMBIA: EL VALLE DE CAUCA: Rio Bugalagrande, Central Cordillera, alt. 1400 m., June 15, 1930, *Dryander 425* (B); CUNDINAMARCA: Girardot, July, 1930, *Arbelaez 358* (US); MAGDALENA: Barranquilla and vicinity, Usiacuri, alt. 250 m., July, 1927, *Elias 269* (MBG, US); Santo Tomas, July, 1932, *Elias 1009* (FM, MBG, US); Santa Marta, April 11, 1926, *Schultze 319* (B); Santa Marta, 1898–1899, *Smith 1650* (D, MBG, US).

BRITISH GUIANA: Assakatta, Northwest District, Sept. 18–28, 1923, *Cruz 4285* (FM, G); Comaca, Moruka River, Pomeroon District, Aug. 26, 1921, *Cruz 1068* (G).

The resurrection of Jacquin's *P. inodora* at this late date undoubtedly is difficult, since authentic herbarium specimens are unavailable. However, the short original diagnosis of plants growing at Cartagena appears to apply fairly well to our plants, and the statement "folia Plumeriae rubrae; flores congeneribus duplo majores" has particular bearing, as plants referable to *P. inodora* as interpreted here almost invariably have been relegated to *P. rubra,* even by certain specialists in Apocynaceae. Bro. Elias reports the common name in Colombia as "Florón."

2. PLUMERIA PUDICA Jacq. Select. Stirp. Amer. Hist. **1**: 37. 1763.

Plumiera caracasana Johnston, Contr. U. S. Nat. Herb. **12**: 108. 1908.

Plumeria cochleata Blake, Contr. Gray Herb. n. s. No. 53: 47. 1918.

COLOMBIA: MAGDALENA: Dibulla, between sea-level and 400 m. alt., July, 1932, *Seifriz 221* (US); Santa Marta, Aug., 1844, *Goudot s.n.* (MP).

VENEZUELA: FALCON: between Coro and Alta Gracia, May 1, 1917, *Curran & Haman 742* (G, US); vicinity of La Boca, May 1, 1917, *Curran & Haman 742A* (G); Cabo Blanco, June 11, 1917, *Curran & Haman 934* (G, US); hills of Cabo Blanco, Aug. 7, 1927, *Pittier 12426* (B, D, M, MBG, US); Cerro Sta. Ana, Para-

guana Pen., April 12, 1917, *Curran & Haman 601A* (G); DISTR. FEDERAL: La Guaira, July 13, 1900, *Robinson & Lyon s.n.* (US); between Caracas and La Guayra, alt. 1500 ft., Aug. 16, 1855, *Fendler 1026* (G); Curucuti, near Maiquetia, May 15–June, 1922, *Pittier 10353* (B, D, G, US); NUEVA ESPARTA: El Valle, Margarita, July 24, 1901, *Miller & Johnston 163* (G); same locality and date, *Miller & Johnston 100* (G, MBG, US).

MARTINIQUE: Fort de France, St. Pierre, cultivé sur les cemetières, 1885, *Duss 336* (NY, US).

Much the same difficulties attend the present interpretation of *P. pudica* Jacq. as that of *P. inodora.* In relegating the cited specimens to the former, disused almost continuously since its publication, particular emphasis has been placed upon the description of the leaves ("Folia oblonga, frondosa, plana, venosaque. . .") and the simple statement of its provenience as from Curaçao, within the general distribution of the species as here interpreted. Conscientious objection may arise in some quarters against the resurrection of a somewhat ambiguous name in place of two such as *P. caracasana* and *P. cochleata* which are established with extant type specimens; but I am personally opposed to the disregard of any name proposed in such an objective work as that of Jacquin's 'Stirpes' when any positive evidence whatsoever is available for interpretation.

3. PLUMERIA RUBRA L. Sp. Pl. ed. 1. **1**: 209. 1753; A. DC. in DC. Prodr. **8**: 390. 1844; K. Sch. in Engl. & Prantl, Nat. Pflanzenfam. **4**^{2}: 136. 1895.

Plumeria acuminata Ait. Hort. Kew. **2**: 70. 1789; K. Sch. in Engl. & Prantl, Nat. Pflanzenfam. **4**^{2}: 136. 1895.

Plumieria purpurea R. & P. Fl. Peruv. **2**: 20. *pl. 137.* 1799; A. DC. in DC. Prodr. **8**: 390. 1844; K. Sch. in Engl. & Prantl, Nat. Pflanzenfam. **4**^{2}: 136. 1895.

Plumieria incarnata R. & P. Fl. Peruv. **2**: 20. *pl. 138.* 1799; A. DC. in DC. Prodr. **8**: 390. 1844.

Plumieria tricolor R. & P. Fl. Peruv. **2**: 20. *pl. 139.* 1799; A. DC. in DC. Prodr. **8**: 390. 1844.

Plumieria carinata R. & P. Fl. Peruv. **2**: 21. *pl. 140.* 1799; A. DC. in DC. Prodr. **8**: 390. 1844.

Plumieria bicolor R. & P. Fl. Peruv. **2**: 21. *pl. 141.* 1799; A. DC. in DC. Prodr. **8**: 391. 1844.

Plumieria lutea R. & P. Fl. Peruv. **2**: 21. *pl. 142.* 1799; A. DC. in DC. Prodr. **8**: 391. 1844; K. Sch. in Engl. & Prantl, Nat. Pflanzenfam. **4**^{2}: 136. 1895.

Plumeria acutifolia Poir. Encycl. Suppl. **2**: 667. 1812; A. DC. in DC. Prodr. **8**: 392. 1844.

Plumeria mollis HBK. Nov. Gen. **3**: 230. 1819; A. DC. in DC. Prodr. **8**: 393. 1844.

Plumieria mexicana Lodd. Bot. Cab. *pl. 1024.* 1825.

Plumeria Lambertiana Lindl. Bot. Reg. *pl. 1378.* 1830; A. DC. in DC. Prodr. **8**: 391. 1844; K. Sch. in Engl. & Prantl, Nat. Pflanzenfam. **4**^{2}: 136. 1895.

Plumeria Milleri G. Don, Gen. Hist. **4**: 93. 1838.

Plumiera arborescens G. Don, Gen. Hist. **4**: 93. 1838.

Plumiera Kerrii G. Don, Gen. Hist. **4**: 93. 1838.

Plumeria incarnata R. & P. β. *Milleri* (G. Don) A. DC. in DC. Prodr. **8**: 390. 1844.

Plumeria megaphylla A. DC. in DC. Prodr. **8**: 391. 1844.

Plumeria acutifolia Poir. β. *Gasparrini* A. DC. in DC. Prodr. **8**: 393. 1844.

Plumieria Jamesoni Hook. Bot. Mag. *pl. 4751.* 1853; K. Sch. in Engl. & Prantl, Nat. Pflanzenfam. **4**^{2}: 136. 1895.

Plumeria loranthifolia Muell.-Arg. in Mart. Fl. Bras. **6**^{1}: 42. 1860; K. Sch. in Engl. & Prantl, Nat. Pflanzenfam. **4**: 136. 1895.

MEXICO: BAJA CALIFORNIA: San Jose del Cabo, Sept. 24, 1890, *Brandegee 358* (G, US); Valle Flojo to El Pescadero, alt. 200–500 ft., Dec. 26, 1905, *Nelson & Goldman 7351* (MBG, US); CAMPECHE: Conhuas, Febr. 23, 1932, *Lundell 1375* (NY, US); CHIAPAS: near Chicharras, alt. 6000 ft., Febr., 12–15, 1896, *Nelson 3804* (US); San Vicente, April 16, 1904, *Goldman 856* (US); CHIHUAHUA: data incomplete, 1885, *Palmer 231* (G, US); COLIMA: Colima, July 2, 1892, *Jones 351* (US); Manzanillo, March 2–18, 1891, *Palmer 1394* (G, US); GUERRERO: Las Seibas, alt. 250 m., May 24, 1898, *Langlassé 196* (B, D, G, US); Acapulco and vicinity Oct., 1894–March, 1895, *Palmer 407* (US); HIDALGO: on dry cliffs near Tula, alt. 6800 ft., May 5, 1898, *Pringle 6830* (BB, Bx, D, G, M, MBG, MP, NY, S, US); prope Huejatla, April, 1888, *Seler & Seler 662* (B, G); Ixmiquilpan, May, 1905, *Purpus 1260A* (MBG, NY); JALISCO: Chiquilistlan, May 30, 1892, *Jones 350* (MBG, US); slopes of barranca near Guadalajara, May–Sept., 1891, *Pringle 3712* (B, BB, Bx, G, M, MBG, MP, NY, S, US); Baranca, near Guadalajara, June, 1886, *Palmer 137* (BB, G, NY, US); MORELOS: lava fields near Cuer-

navaca, alt. 5000 ft., May 11, 1898, *Pringle 6866* (B, BB, Bx, D, G, M, MBG, MP, NY, S, US); prope Hacienda Gaspar, Distr. Cuernavaca, Dec., 1877, *Seler & Seler 356* (B); San Antonio, Nov. 12, *Fröderstrom & Hulten 79* (S); NAYARIT: Acaponeta, June, 1897, *Rose 1486* (G, MBG, US); OAXACA: Huanchilla, alt. 1200 m., June, 1901, *Conzatti & Gonzalez 1209* (G); Rio Seco, alt. 3300 ft., June 1, 1895, *Smith 387* (G); Cerro Caballito Blanco, alt. 1700 m., April 20, 1920, *Conzatti 3934* (US); Cuesta de Quiotepec, alt. 1100 m., April 23, 1919, *Conzatti 3554* (US); Cerro Concordia, alt. 800–1000 m., April 17, 1933, *Morton & Makrinius 2728* (US); vicinity of Comaltepec, alt. 1800–3000 ft., July 30–31, 1894, *Nelson 935* (US); six miles above Dominguillo, alt. 4500–5500 ft., Oct. 30, 1894, *Nelson 1879* (US); near Reyes, alt. 5800–6700 ft., Oct. 20, 1894, *Nelson 1779* (G); Villa Alta, Cerro de Yalina, alt. 1500 m., June, 1899, *Conzatti 962* (G); Sta. Catarina, 1910, *Olssen & Seffer s.n.* (MBG); Hacienda "Los Bocas de Concepçion," Aug. 22, 1909, *Olssen & Seffer s.n.* (MBG); PUEBLA: Santa Lucia, June, 1908, *Purpus 3240* (MBG); Tehuacan, June, 1905, *Purpus 1260* (NY); region d'Orizaba, May 12, 1865, *Bourgeau 2415* (BB, Bx, G, MP, S); QUERETARO: data incomplete, 1910–13, *Aguiel 10343* (US); SINALOA: Mazatlan, June 17–19, 1897, *Rose 1392* (US); Zapote, 1923, *Ortega 5202* (US); dry hills, vicinity of San Blas, March 22, 1910, *Rose Standley & Russell 13234* (US); SONORA: Sierra de Alamas, March 14, 1910, *Rose Standley & Russell 12852* (US); VERA CRUZ: Papantla, June, 1841, *Liebman 11911* (G, US); YUCATAN: La Vega, March 14–26, 1901, *Goldman 629* (US); forest, Chichen Itza, June 20, 1932, *Steere 1436* (MBG).

GUATEMALA: AMATITLAN: Laguna Amatitlan, alt. 3900 pp., Febr., 1890, *Smith 1920* (US); EL PROGRESO: Barranquillo, April 21, 1920, *Popenoe 981* (US); ESCUINTLA: Escuintla, alt. 1100 pp., March, 1890, *Smith 1893* (G, US); IZABAL: vicinity of Quirigua, alt. 75–225 m., May 15–31, 1922, *Standley 24318* (G, US); PETEN: occupied clearing, La Libertad, April 26, 1933, *Lundell 3023* (MBG, S); RETALHULEU: Caballo Blanco, alt. 250 pp., April, 1892, *Smith 2767* (G, US); San Felipe, alt. 2050 pp., April, 1892, *Smith 2771* (NY, US); SANTA ROSA: Santa Rosa, alt. 2500 pp., May, 1892, *Heyde & Lux 2959* (G, US); SUCHITEPEQUEZ: Cuyotenango, alt. 1100 pp., April, 1892, *Smith 2768* (G, NY, US).

HONDURAS: COMAYAGUA: cut-over valley lands, San Luis, alt. 2500 ft., May 11, 1933, *Edwards 599* (US); SANTA BARBARA: San Pedro Sula, alt. 1200 pp., Aug., 1888, *Thieme 5344* (B, BB, D, G, M, NY, US).

BRITISH HONDURAS: Roaring Creek, Aug., 1929, *Lundell 468* (MBG, US); El Cayo and vicinity, March–June, 1933, *Chanek 37* (MBG).

EL SALVADOR: vicinity of San Salvador, alt. 650–850 m., March 30–April 24, 1922, *Standley 23617* (NY, US); Huizucar, April, 1929, *Calderon 2527* (FM, US).

NICARAGUA: CHINANDEGA: Chinandega, Jan. 20, 1903, *Baker 69* (G, US); GRANADA: env. de Granada, Febr., 1870, *Levy 427* (BB, D); MANAGUA: Momotombo, June, 1895, *Smith 139* (G, MBG, NY, US); MASAYA: southwestern slopes of Santiago Volcano, near Masaya, alt. 300–480 m., July 5, 1923, *Maxon 7666* (US).

COSTA RICA: GUANACASTE: pentes rocheuses des collines de Nicoya, Jan., 1900, *Tonduz 13681* (B, BB, G, US); sur les rochers de la Baie de Salinas, July, 1890, *Pittier 2622* (BB, Bx, US); autour de maisons à Santo Domingo de Golfo Dulce, May, 1896, *Tonduz 9919* (Bx, US).

PANAMA: CHIRIQUÍ: vicinity of San Felix, alt. 0–120 m., Dec., 1911, *Pittier 5289* (US); COCLÉ: Penonomé and vicinity, alt. 50–1000 m., Febr. 23–March 22,

1908, *Williams 620* (NY); PANAMÁ: Taboga Island, Jan. 25, 1935, *Allen 133* (MBG); CANAL ZONE: Corozal, Jan. 16, 1922, *Greenman & Greenman 5212* (MBG).

I believe that the foregoing specimens approximate the natural distribution of *P. rubra,* augmented considerably, no doubt, by cultivation and escape. The specimens following, I believe to be the result of cultivation, and are of interest chiefly from the standpoint of dynamic floristics of cultivated ruderals. Beside the following records from America, there are also many herbarium records of the species from the Philippine Islands, Hawaii, Formosa, Indo-China, India, and Africa, which are obviously without the general scope of this paper.

UNITED STATES: FLORIDA: Miami, cultivated, Aug. 27, 1929, *Irving s.n.* (US).

BERMUDA: Somerset Island, planted, Aug. 27–Sept. 21, 1912, *Brown & Britton 1009* (NY).

BAHAMA ISLANDS: ANDROS: Mastic Pt., June, 1890, *Northrop & Northrop 601* (B, NY); Mangrove Cay, 1904, *Bryant 6* (G).

CUBA: CAMAGUEY: Camaguey, gardens, April 2–7, 1912, *Britton Britton & Cowell 13218* (NY, US); HAVANA: Santiago de la Vega, 1904, *Hermann 234* (FM, NY); ORIENTE: prope villam Monte Verde, Jan.–July, 1859, *Wright s.n.* (G); SANTA CLARA: Soledad, Cienfuegos, Aug. 20, 1927, *Jack 5320* (NY).

HISPANIOLA: HAITI: vicinity of St. Louis du Nord, cemetery, April 7, 1929, *Leonard & Leonard 14597* (US); Massif de la Selle, Port-au-Prince, Montfleury, Aug. 11, 1926, *Ekman 6618* (B, S, US); vicinity of Cap Haitien, July 23, 1920, *Leonard 5314* (NY, US);

JAMAICA: Stony Hill, Mount Pleasant, growing in open situations, July 21, 1912, *Harris 11126* (G, NY, US); data incomplete, *Alexander s.n.* (NY).

PUERTO RICO: near Ponce, July 8, 1901, *Underwood & Griggs 695* (NY, US); Bayamon, May 19, 1916, *Stevenson 5357* (US).

VIRGIN ISLANDS: ST. CROIX: Bassin, April 7, 1896, *Ricksecker 360* (G, MBG, NY).

GUADELOUPE: Basse-Terre, introduit et cultivé, 1899, *Duss 2839* (B, NY).

BRITISH WEST INDIES: ST. VINCENT: leeward side, second growth, naturalized sparingly, alt. 100 ft., Oct., 1890, *Smith & Smith 550* (B, NY); ST. KITTS: Molyneaux estate, planted along road, Sept. 8–Oct. 5, 1901, *Britton & Cowell 278* (NY); GRENADA: The Bower, St. George's, April 11, 1905, *Broadway 1799* (G, NY); UNION: leeward side at Chatham Bay, March 26, 1933, *Cooper 207* (NY); TOBAGO: Botanic Garden Station, cultivated, April 12, 1913, *Broadway 2994* (G, MBG, MP, S, US).

COLOMBIA: CAUCA: La Paila, May, 1853, *Holton s.n.* (BB, D, G).

VENEZUELA: ARAGUA: La Victoria, alt. 2000 ft., Dec. 15, 1856, *Fendler 2108* (G); Mission Station Maracay (St. Ottlien), Oct., 1925, *Zehntner s.n.* (M); BOLIVAR (?): in insula Panuramae (Orinoco), date lacking, *Bonpland 1138* (B).

BRAZIL: CEARA: planted in yards, Maranguape, Nov. 6, 1935, *Drouet 2678* (G); MATTO GROSSO: Cuyaba, Febr. 12, 1894, *Malme 1398* (S); data incomplete, *Wed-*

dell 3423 (M); MINAS GERAES: Serrados Vertentes, Aug. 22, 1882, *Glaziou 14070* (MP); PARA: Para, May, 1820, *Martius 267* (M); data incomplete, *Burchell 10069* (G, MP); PERNAMBUCO: Tapera, cultivated, Febr. 9, 1934, *Pickel 3504* (US).

ECUADOR: CHIMBORAZO: vicinity of Huigra, mostly on the Hacienda de Licay, cultivated, said to come from the coast, Sept. 5, 1918, *Rose & Rose 22528* (US); EL ORO: vicinity of Santa Rosa, Oct. 17–18, 1918, *Rose & Rose 23486* (US); GUAYAS: westlich Guayaquil, Buschwald, alt. 20 m., Nov. 7, 1933, *Schimpff 407* (MBG); base of Cerro Santa Ana, alt. 10 m., cultivated, Dec. 6, 1934, *Mexia 6747* (MBG).

PERU: LORETO: forest, Mishuyacu, near Iquitos, alt. 100 m., Oct.–Nov., 1929, *Klug 100* (US); dense forest, Rio Maranon valley, alt. 150 m., Aug. 20–Sept. 8, 1929, *Killip Smith & Dennis 29226* (US); dense forest, Yurimaguas, lower Rio Huallaga, alt. 135 m., Aug. 23–Sept. 7, 1929, *Killip & Smith 27710* (US).

The variability of the corolla color of *P. rubra* already has been discussed. For the benefit of those who wish distinction in this matter, it probably is permissible to recognize the following color forms, which represent only the more prevalent variations:

P. RUBRA L. forma **typica**: corolla predominantly rose of varying intensity; usually with a "yellow eye."

P. RUBRA L. forma **lutea** (R. & P.) Woodson, comb. nov.: corolla predominantly yellow, occasionally flushed with rose without.

P. RUBRA L. forma **acutifolia** (Ait.) Woodson, comb. nov.: corolla white, usually with a "yellow eye;" occasionally flushed with rose without.

P. RUBRA L. forma **tricolor** (R. & P.) Woodson, comb. nov.: corolla predominantly white, but the outer margin of the lobes rose; usually with a "yellow eye."

Since the flower color usually is almost completely lost in desiccation, it is not possible to cite specimens consistently for each of these formae. *P. rubra* is the only species of either *Plumeria* or *Himatanthus* with flowers other than white "with a yellow eye"; hence it is easy to assign names which are not represented by existing specimens when the flower color has been noted as other than white, as in the case of *P. loranthifolia* Muell.-Arg., represented now by two very fragmentary specimens from southern and eastern Brazil, but described by the author as probably bearing red flowers. The type of *P. loranthifolia* almost unquestionably is an escape from cultivation

referable with confidence to *P. rubra.* It is further of interest to note that the several species of *Plumeria* described from Peru by Ruiz & Pavon are noted by the authors as occurring "in hortis"; doubtless importations from Mexico or Central America of the *P. rubra* complex.

4. Plumeria obtusa L. Sp. Pl. ed. 1. **1**: 210. 1753; A. DC. in DC. Prodr. **8**: 392. 1844; Britton, Bull. Torrey Bot. Club. **42**: 505. 1915.

var. **typica.**

Plumeria Tenorii Gasp. Oss. Piant. Ort. Boccad. p. 20. 1833; A. DC. in DC. Prodr. **8**: 391. 1844.

Plumieria obtusa L. β. *parviflora* Griseb. Mem. Amer. Acad. II. **8**: 519. 1862.

Plumieria obtusa L. γ. *laevis* Griseb. Mem. Amer. Acad. II. **8**: 519. 1862.

Plumeria clusioides Griseb. Cat. Pl. Cub. 171. 1866; Britton, Bull. Torrey Bot. Club **42**: 504. 1915.

Plumieria emarginata Griseb. Cat. Pl. Cub. 171. 1866; Britton, Bull. Torrey Bot. Club **42**: 505. 1915.

Plumieria clusioides Griseb. var. *parviflora* Maza, Ann. Soc. Esp. Hist. Nat. **23**: 273. 1895.

Plumieria Krugii Urb. Symb. Ant. **1**: 387. 1900.

Plumieria bahamensis Urb. Symb. Ant. **1**: 387. 1900.

Plumieria portoricensis Urb. Symb. Ant. **1**: 387. 1900.

Plumieria Marchii Urb. Symb. Ant. **3**: 334. 1902.

Plumiera inaguensis Britton, Bull. N. Y. Bot. Gard. **3**: 448. 1905.

Plumiera jamaicensis Britton, Bull. Torrey Bot. Club **37**: 356. 1910.

Plumiera confusa Britton, Bull. Torrey Bot. Club **42**: 505. 1915.

Plumiera nipensis Britton, Bull. Torrey Bot. Club **42**: 505. 1915.

Plumieria venosa Britton, Bull. Torrey Bot. Club **42**: 506. 1915.

Plumeria barahonensis Urb. in Fedde, Repert. Spec. Nov. **14**: 341. 1916.

Plumeria apiculata Urb. in Fedde, Repert. Spec. Nov. **16**: 36. 1919.

Plumiera montana Britton & Wils. Bull. Torrey Bot. Club **50**: 46. 1923.

Plumeria Ostenfeldii Urb. Dansk Bot. Arkiv **4**[7]: 8. *pl. 2.* 1924.

Plumeria beatensis Urb. Dansk Bot. Arkiv **4**[7]: 9. 1924.

Plumeria dictyophylla Urb. Symb. Ant. **9**: 239. 1924.

Plumeria estrellensis Urb. Symb. Ant. **9**: 240. 1924.

Plumeria Ekmanii Urb. Symb. Ant. **9**: 239. 1924.

Plumeria cubensis Urb. in Fedde, Repert. Spec. Nov. **21**: 219. 1925.

Plumeria cayensis Urb. in Fedde, Repert. Spec. Nov. **21**: 218. 1925.

Plumeria cuneifolia Helwig, Arkiv f. Bot. **22A**[10]: 44. 1929.

Plants wholly glabrous throughout.

BAHAMA ISLANDS: ABACO: coppice, Eight-Mile Bay, Dec. 27, 1904, *Brace 1891* (NY); ACKLIN'S: Spring Point, Dec. 21–Jan. 6, 1906, *Brace 4275* (NY); ANDROS: Fresh Creek, June 11, 1890, *Northrop & Northrop 651* (B, BB, G, NY); CAT: Nov. 20, 1890, *Hitchcock s.n.* (MBG); CROOKED: Gun Bluff, Jan. 9–23, 1906, *Brace 4701* (NY); ELEUTHERA: Rock Sound and vicinity, Febr. 21–22, 1907, *Britton & Millspaugh 5565* (NY); GRAND TURK: scrub, Aug. 27–Sept. 1, 1905, *Nash & Taylor 3799* (US); GREAT BAHAMA: coppice, Pinder's Point, Febr. 5–13, 1905, *Britton & Millspaugh 2522* (NY); GUN CAY: April 15, 1904, *Millspaugh 2316* (FM, NY); INAGUA: Dec. 4, 1890, *Hitchcock s.n.* (MBG); LONG CAY: Hanna Hill, Dec. 7–17, 1905, *Brace 4013* (NY, US); NEW PROVIDENCE: coastal thickets near caves, Aug. 26, 1904, *Britton & Brace 299* (G, NY, US); HOG: June 7, 1909, *Wilson 8424* (NY); PROVIDENCIALES: Dec. 19, 1907, *Wilson 7750* (NY); RUM CAY: Jan. 6, 1932, *Fairchild 2570* (MBG, US); SHIP CHANNEL CAY: on rocks, Febr. 17, 1905, *Britton & Millspaugh 2757* (NY); SOUTH CAICOS: East Harbor and vicinity, March 6–7, 1911, *Millspaugh & Millspaugh 9233* (NY); WATLING'S: Cockburn Town and vicinity, March 12–13, 1907, *Britton & Millspaugh 6074* (NY); WEST CAICOS: Dec. 20, 1907, *Wilson 7757* (NY).

CUBA: CAMAGUEY: vicinity of Pueblo, Cayo Romano, Oct. 8–9, 1909, *Shafer 2470* (NY, US); on limestone tuffs, Pastelillo, June 24, 1924, *Ekman 19070* (S); Cayo Sabinal, ad marginem sylvae, Oct. 17, 1922, *Ekman 15529* (B, S); HAVANA: Yata Hills, Guanabacoa, July 19, 1917, *Leon 7337* (NY); ad Rio Quezada in cuabales, May 27, 1923, *Ekman 16448* (B, S); MATANZAS: near Nueva Gerona, Isla de Pinos, June 4, 1904, *Curtiss 524* (B, D, G, M, MBG, US); prope Cardenas, in rupibus calcareis ad Varadero, July 13, 1923, *Ekman 17138* (B, S); PINAR DEL RIO: in Sierra Organos, May 8, 1922, *Ekman 13769* (B, S); limestone hills, vicinity of Sumidero, July 28–31, 1912, *Shafer 13442* (US); SANTA CLARA: Montes de Bartolina, Aug. 1, 1930, *Leon 14641* (NY); common on rocks near Cienequita, May 15, 1895, *Combs 36* (G, MBG, MP, NY); prope urbem Santa Clara in palme-

citis, June 13, 1922, *Ekman 14044* (B, S); ORIENTE: Guana River basin, Aug. 30, 1906, *Taylor 93* (NY); prope Guatanamo, in rupibus calcareis, Oct. 24, 1914, *Ekman 2910* (B, S); prope villam Monte Verde, Jan.–July, 1859, *Wright 1381* (B, BB, Bx, D, G, MBG, MP).

JAMAICA: Plato Road, alt. 3000 ft., June 19, 1899, *Harris 7791* (B); Constant Spring, alt. 600 ft., Aug. 12, 1895, *Campbell 5973* (B); coral rocks on seashore, near Port Antonio, June 23, 1897, *Fredholm 3058* (US); Great Goat Id., Old Harbor Bay, March 4, 1908, *Harris 10168* (B, US); South Shores, Cayman Brac, Febr. 10, 1899, *Millspaugh 1229* (B).

HISPANIOLA: HAITI: limestone terraces west of Saline-Michel, Presqu'ile du Nord-Ouest, Port-de-Paix, Aug. 5, 1925, *Ekmann 4577* (B, S, US); Massif du Nord, Bassin-Zinne, alt. 300 m., May 9, 1926, *Ekman 6053* (S, US); Petite Gonave Is., July 9–10, 1920, *Leonard 5255* (B, US); vicinity of Basse-Terre, Tortue Is., March 27, 1929, *Leonard & Leonard 12505* (US); Massif des Cahos, Pet. Riv. de l'Artibonite, road to Mèdor, March 4, 1925, *Ekman 3381* (S); Massif de la Hotte, Morne Rochelois, Miragoane, limestone hills south of town, July 23, 1926, *Ekman 6483* (B, S); DOMINICAN REPUBLIC: Cordillera Central, Prov. de Samana, June 29, 1930, *Ekman 15486* (US); Beata Is., Febr. 23, 1922, *Ostenfeld 341* (B, NY); Distr. de Moncion, Prov. Monte Cristi, Sept. 5, prope Barahona, alt. 70 m., Aug., 1911, *Fuertes 941* (B, G, US).

PUERTO RICO: prope Maricao, in declivibus montis "Alegrijo," Nov. 26, 1884, *Sintenis 321* (B, G, US); serpentine hillside, Santa Ana, near Sabana Grande, Febr. 9, 1915, *Britton & Cowell 4034* (US); Moca, June 29, 1914, *Johnston 2055* (US); Mona Is., Dec. 20–21, 1913, *Stevens 6184* (NY).

HONDURAS: Coral Rock, Larger Is., Swan Islands, April 2, 1912, *Nelson 77* (G).

var. **sericifolia** (Wright) Woodson, comb. nov.

Plumeria tuberculata Lodd. Bot. Cab. *pl. 681.* 1822; A. DC. in DC. Prodr. **8**: 393. 1844.

Plumieria sericifolia Wright, ex Griseb. Cat. Pl. Cub. 171. 1866; Britton, Bull. Torrey Bot. Club **42**: 504. 1915.

Plumieria emarginata Griseb. β. *sericifolia* (Wright) Gomez, Anal. Soc. Esp. Hist. Nat. **23**: 273. 1894.

Plumieria gibbosa Urb. Symb. Ant. **3**: 338. 1902.

Plumieria domingensis Urb. Symb. Ant. **3**: 338. 1902.

Plumiera lanata Britton, Bull. Torrey Bot. Club **42**: 504. 1915.

Plumiera trinitensis Britton, Bull. Torrey Bot. Club **42**: 506. 1915.

Plumeria casildensis Urb. in Fedde, Repert. Spec. Nov. **21**: 218. 1924.

Plumeria pilosula Urb. Symb. Ant. **9**: 238. 1924.

Plumeria leuconeura Urb. in Fedde, Repert. Spec. Nov. **24**: 8. 1927.

Plumeria multiflora Standl. Field Mus. Publ. Bot. **8**: 33. 1930.

Lower surface of leaves, and frequently petioles and inflorescence, more or less conspicuously pubescent; in all other essential details similar to the typical variety.

UNITED STATES: FLORIDA: Key West, date lacking, *Blodgett s.n.* (US); Miami, cultivated, Aug. 22, 1929, *Irving s.n.* (US).

BAHAMA ISLANDS: INAGUA: Dec. 4, 1890, *Hitchcock s.n.* (FM, MBG, NY).

CUBA: HAVANA: Cojimar, June 6, 1895, *Baker 5129* (B, NY); top of Loma de la Pita, San Miguel, May 20, 1920, *Leon Ekman & Roig 9117* (NY); MATANZAS: mouth of the Bueyvaca, Aug. 28, 1903, *Britton & Wilson 61* (NY); in Pan de Matanzas, solo calcares in sylvis, May 30, 1923, *Ekman 16461* (B, S); ORIENTE: Sabana to Maisi, Dec. 13, 1910, *Shafer 7908* (NY); prope Guantanamo, in rupibus calcareis, Sept. 24, 1914, *Ekman 2909* (B, S); data incomplete, *Wright 2952* (BB, D, G, MBG, NY, US); PINAR DEL RIO: coastal thicket, Bay Mariel, Sept. 21, 1910, *Britton & Earle 7590* (NY); SANTA CLARA: dry hillside, La Vigia Hill, Trinidad, March 14, 1910, *Britton & Wilson 5514* (NY); prope Casilda, in fruticetis litoralibus, March 28, 1924, *Ekman 18877* (B, S).

HISPANIOLA: HAITI: Massif de la Hotte, limestone hills, July 23, 1926, *Ekman 6483* (US); Massif de la Selle, limestone cliffs, July 20, 1926, *Ekman 6681* (S, US); Presqu'ile du Nord-Ouest, Port-de-Paix, May 3, 1925, *Ekman 3995* (S, US); prope Cap Haitien, Dept. du Nord, in the steep limestone rocks of Morne La Vigie, alt. 300 m., Dec. 1, 1924, *Ekman 2716* (B, S); DOMINICAN REPUBLIC: Azua, hill north of town, March 3, 1913, *Rose Fitch & Russell 3862* (NY); rocky scrub, La Romana, Dec. 1–3, 1909, *Taylor 378* (NY); Magua, alt. 300–400 m., April 8, 1933, *Valeur 969* (MBG, NY); in thickets toward El Fronton, Cabo Samana, June 18, 1930, *Ekman 15340* (S); prope Susua, circa Puerto Grande, in rupibus calcareis ad maris litus, June 22, 1887, *Eggers 2593* (B).

MEXICO: YUCATAN: in forest, Chichen Itza, June 15, 1932, *Steere 1320* (MBG); southeast, Kancabconot, May, 1917, *Gaumer 23880* (FM, MBG, NY, US).

BRITISH HONDURAS: Honey Camp, Sept., 1928, *Lundell X* (US).

5. PLUMERIA FILIFOLIA Griseb. Mem. Amer. Acad. II. **8**: 519. 1862; Britton, Bull. Torrey Bot. Club **42**: 504. 1915.

Plumeria stenophylla Urb. Symb. Ant. **9**: 237. 1924.

CUBA: ORIENTE: river cliffs, Ensenada de Mora, March 26–29, 1912, *Britton Cowell & Shafer 12951* (US); Daiquiri, in collibus calcareis ad Papaya, Nov. 18, 1916, *Ekman 8393* (B, S); prope Palmarito de Cauto, in collibus calcareis "Mogote," alt. 300 m., April 10, 1918, *Ekman 9175* (B, S); Bayate, Picote im cacum, montis c. 550 m., July 16, 1916, *Ekman 7409* (S); Maria Pilar, ad Rio Baconas in collibus siccis (solo eruptivo), Nov. 5, 1916, *Ekman 8236* (S); in rupibus calcar. ad Rio Jimbambay, Sierra de Nipe, April 27, 1919, *Ekman 9569* (B); top of mountain, Palmarito de Canto, June 27, 1924, *Ekman 19087* (S); data incomplete, 1860, *Wright 1660* (B, BB, Bx, D, G, MBG, ISOTYPES).

6. PLUMERIA ALBA L. Sp. Pl. ed. 1. **1**: 210. 1753; A. DC. in DC. Prodr. **8**: 392. 1844; K. Sch. in Engl. & Prantl, Nat. Pflanzenfam. **4**^{2}: 136. 1895.

Plumeria hypoleuca Gasp. Oss. Piant. Ort. Boccad. p. 20. 1833; A. DC. in DC. Prodr. **8**: 392. 1844.

Plumeria hypoleuca Gasp. β. *angustifolia* Gasp. Oss. Piant. Ort. Boccad. p. 20. 1833.

Plumeria alba L. β. *Jacquiniana* A. DC. in DC. Prodr. **8**: 392. 1844.

PUERTO RICO: coastal thickets, Dorado, Febr. 13, 1914, *Britton & Cowell 1499* (NY, US); Manati, June 13, 1914, *Stevenson 548* (US); Fajardo, in fruticetis, May 20, 1885, *Sintenis 1633* (G, US); very dry hillside with cactus, Agaves, etc., Coama Springs, July 1, 1901, *Underwood & Griggs 543* (US); Arecibo, May 21, 1913, *Stevens 1776* (NY); thicket, Vieques Is., Febr. 7, 1914, *Shafer 2766* (MBG, NY, US); prope Bayamon in petrosis maritimis, June, 1886, *Stahl 546* (B).

VIRGIN ISLANDS: ST. CROIX: Salt River, May 15, 1896, *Ricksecker 395* (G, MBG, NY, US); ST. JOHN: mountain slopes, rocky soil, June 22, 1921, *Morrow 147* (US); ST. THOMAS: hillside thicket, Cowell Point, Jan. 31–Febr. 4, 1913, *Britton Britton & Shafer 86* (NY, US); hillside, Buck Is., Febr. 7, 1913, *Britton & Shafer 377* (NY, US).

BRITISH WEST INDIES: ANAGADA: rocky plain near settlement, Febr. 19–20, 1913, *Britton & Fishlock 1059* (NY); ANTIGUA: near Cades Bay, Febr. 10, 1913, *Rose Fitch & Russell 3405* (NY, US); BECQUIA: data incomplete, *Smith & Smith B99* (G); GRENADA: Quarentine Station, St. George's, May 22, 1906, *Broadway s.n.* (NY); MONTSERRAT: dry hillside, Bransby Point, Jan. 21, 1907, *Shafer 108* (NY, US); TORTOLA: rocky hillside, road to Sea Cove Bay, Febr. 13–17, 1913, *Britton & Shafer 682* (NY, US); VIRGIN GORDA: coastal hills, Little Dix Bay, Nov. 13, 1918, *Fishlock 79* (NY).

FRENCH WEST INDIES: GUADELOUPE: endroits secs et rocailleux, 1903, *Duss 2838* (B, NY, US); MARTINIQUE: endroits rocailleux, Ste. Anne, 1883, *Duss 1863* (B, NY, US).

DUTCH WEST INDIES: ST. MARTIN: hedges, Sept. 6, 1901, *Britton & Cowell 80* (NY); SABA: 1906, *Boldingh 1354* (B, NY).

This certainly is the most constant species of *Plumeria.* The peculiar form of "puckered" revolution of the desiccated leaves is one of the most characteristic features of *P. alba,* and is well shown in the old plates in Miller's 'Dictionary.'

7. PLUMERIA SUBSESSILIS A. DC. in DC. Prodr. **8**: 393. 1844.

Plumeria Berterii A. DC. in DC. **8**: 393. 1844.

Plumeria Jaegeri Muell.-Arg. Linnaea **30**: 397. 1860.

HISPANIOLA: HAITI: Morne Dumais, in declivibus siccis, alt. 1000 m., Aug., 1916, *Buch 1341* (B, US); Massif de la Selle, between Fort-Jacques and Cadets, alt.

1100–1200 m., Sept. 7, 1924, *Ekman 1806* (S, US); Massif des Matheux, Thomazeau, Morne-à-Cabrits, alt. 350 m., May 17, 1928, *Ekman 9977* (B, US); Port-au-Prince to Petionville, alt. 500 ft., hillside, Sept. 6, 1903, *Nash 964* (NY); arid foothill, vicinity of Fond Parisien, Étang Saumatre, May 5–13, 1920, *Leonard 4150* (NY, US); arid foothills, vicinity of Petionville, alt. 350 m., June 15–28, 1920, *Leonard 4844* (NY, US); banks along road from Petionville to Port-au-Prince, May 19–23, 1929, *Leonard & Leonard 15822* (NY, US); Monte Cabrete, Aug. 26, 1917, *Cook Scofield & Doyle 73* (US); in alpibus montis La Coupe, June 30, 1928, *Jaeger 194* (B, G, NY, S, US); DOMINICAN REPUBLIC: vicinity of Constanza, April 10–May 15, 1919, *Abbott s.n.* (US); Barahona, alt. 300 m., March, 1911, *Fuertes 883* (B, D, US); prope Mamil de Ocoa, alt. 300 m., in declivibus apricis, Oct., 1910, *Tuerckheim 3754* (M, NY); Arroya de Voca, March 20, 1922, *von Schrenk 39* (MBG); Azua, Bohios del Canal, steep hillside, c. 750 m., March 26, 1929, *Ekman 12057* (B, S).

The peculiar form and venation of the foliage render this perhaps the most distinctive species of *Plumeria*. Its possible hybridization with other species is treated in the following paragraphs.

EVIDENCES OF HYBRIDIZATION IN THE GENUS PLUMERIA

As one examines a representative suite of herbarium specimens of *Plumeria* from Hispaniola, one is struck by the great variability of the plants from the Republic of Haiti. This variation is not more or less quantitative, as that of *P. obtusa* in Cuba, for example, but is rather conspicuously qualitative as well. The great diversification of Plumerias in Haiti has prompted several specific segregates by Urban and Ekman. Far from producing the desired result of more concise identification, however, the recent "splitting" of species has led only to confusion in correlating an increasing diversification of leaf forms with the published descriptions.

In an attempt to solve the problem of variation of the Haitian Plumerias, one is confronted at the outset, as has been implied, with the fact that Hispaniola is the only land mass where such a condition occurs. Secondly, one remembers *P. subsessilis,* which is endemic to Hispaniola, and its peculiar, subsessile leaves with exceedingly prominent venation with secondary veins abruptly entering the midrib at a conspicuously decurrent angle. The occurrence of modifications of the peculiar venation of *P. subsessilis* is found to a greater or lesser extent

in specimens of the recently segregated "species," together with a marked tendency toward the continuously arcuate or subhorizontal venation of other species of *Plumeria;* and almost at once suggests the explanation of the coincident variability of the genus in Hispaniola and the endemism of *P. subsessilis* upon the basis of interfertility of that species with other neighboring congeners.

Beside *P. subsessilis,* both *P. obtusa* L. (two varieties) and *P. rubra* L. occur in Haiti, the former probably indigenous, the latter doubtless introduced. The characteristics of these three putative parents of the supposed hybrids may be summarized as follows:

P. subsessilis A. DC. Leaves oblong to oblong-obovate, obtuse to very abruptly acuminate, subsessile, 8–24 cm. long, 2.5–5.5 cm. broad, rather delicately membranaceous, the secondary veins departing from the leaf margin subhorizontally or in a broad arc, abruptly entering the midrib at an acute, conspicuously decurrent angle; aestivation of corolla-lobes somewhat spiral; flowers white "with a yellow eye"; plants wholly glabrous.

P. rubra L. Leaves broadly elliptic, obovate to oblong-oblanceolate, obtuse to acuminate, long-petiolate, 12–50 cm. long, 3.5–15.0 cm. broad, firmly membranaceous, opaque, wholly glabrous to densely pubescent beneath, the secondary venation broadly arcuate to essentially rectilinear, sometimes entering the midrib in an inconspicuously decurrent fashion; inflorescence glabrous to more or less pubescent; corolla white "with a yellow eye" to various shades of rose and yellow, occasionally particolored, aestivation of the lobes strikingly spiral.

P. obtusa L. Leaves obovate to obovate-oblong, obtuse or rounded to very shortly acuminate, 3.5–18.0 cm. long, 1.0–8.5 cm. broad, manifestly petiolate, coriaceous to subcoriaceous, more or less lustrous above, wholly glabrous to densely pubescent beneath, secondary venation continuously oblique or subhorizontal, essentially rectilinear, directly entering the midrib; inflorescence glabrous; corolla white "with a yellow eye," aestivation of the lobes nearly longitudinal or only slightly spiral.

As one examines the supposed hybrids, it is found possible to sort them roughly into two groups as follows:

Group 1: Very closely resembling *P. subsessilis,* but leaves with less characteristic venation, and with petioles 0.5–2.5 cm. long; inflorescence tending to be pubescent in some cases, and leaves more nearly elliptic, but still rather delicately membranaceous and not at all coriaceous, occasionally somewhat pubescent:

HAITI: Massif des Matheux, July 15, 1924, *Ekman 904* (US); Massif des Matheux, Thomazeau, May 17, 1928, *Ekman 9975* (US); same locality, July 3, 1927, *Ekman 8563* (B); Morne à Cabrits, July 14, 1924, *Ekman 889* (B, TYPE of *P. longiflora* Urb. & Ekm.); Morne à Cabrits, July 3, 1927, *Eyerdam 3* (G,

US); in territorio Plaine, July, 1900, *Buch 348* (B, TYPE of *P. Paulinae*, NY, ISOTYPE); in Plaine ad M. Mori, July, 1897, *Picarda 1608* (B, TYPE of *P. stenopetala* Urb.); Gonaives, plain, alt. 400 ft., Aug. 16, 1905, *Nash & Taylor 1774* (NY); Massif des Matheux, Croix-des-Bouquets, July 18, 1924, *Ekman 972* (US); Coupe de Pintad, Aug. 21, 1924, *Cook 11* (NY, US).

Group 2: Leaves broadly elliptic to obovate-elliptic, broadly acuminate, 12–35 cm. long, 3–11 cm. broad, firmly membranaceous, opaque above, densely pubescent to glabrate beneath, secondary venation mostly broadly arcuate, frequently with a trace of the decurrent entry to the midrib characteristic of *P. subsessilis;* petioles 1–7 cm. long; inflorescence occasionally somewhat pubescent; flowers white "with a yellow eye," occasionally "yellow at base," or "bud purplish without," aestivation of the lobes somewhat spiral:

HAITI: Dog Mountain, vicinity of Bombardopolis, Febr. 21–26, 1929, *Leonard & Leonard 13531* (MBG, US); vicinity of Mole St. Nicholas, Mole Gorge, arid thickets, Febr. 16, 1929, *Leonard & Leonard 3315* (US); vicinity of Bassin Bleu, arid mountain several miles west of town, April 17, 1929, *Leonard & Leonard 14769* (US); trail to Moustique Mts., vicinity of Bassin Bleu, April 21, 1929, *Leonard & Leonard 14930* (US); Massif de la Hotte, Jeremie, between Sources-Chaudes and Source-Cahouane, July 4, 1928, *Ekman 10239* (US); Massif de la Selle, prope Nouvelle Tourraine, Aug. 7, 1924, *Ekman 1359* (B, TYPE of *P. discolor* Urb. & Ekm., US, ISOTYPE); Massif de la Selle, Rio de la Gorge, in rocks, Febr. 13, 1925, *Ekman 3224* (B); dry lands along Puilboreau Road, vicinity of Ennery, Jan. 17, 1926, *Leonard 8900* (G, NY, US); Massif des Matheux, May 8, 1927, *Ekman 8084* (US); Massif de la Hotte, prope Petit-Goave, Aug. 1, 1926, *Ekman 6565* (B); Port-au-Prince, in horto cult., Oct. 6, 1924, *Ekman 2053* (B); inter Massif de la Selle et La Hotte prope Trouin, in collibus calc. ad rivulum, 500 m., alt., Nov. 5, 1924, *Ekman 2378* (B, TYPE of *P. trouinensis* Urb. & Ekm.); Massif de la Hotte, Grand-Goave, road Carrefour-Fauche to Trouin, in limestone hills, April 16, 1926, *Ekman 5867* (B, US); vicinity of Cabaret, Baie des Moustiques, Jan. 15, 1929, *Leonard & Leonard 12033* (US); Massif de la Selle, between Bois d'Orme and Dessoziers, April 19, 1926, *Ekman 5880* (B); La Brand to Mt. Balance, xerophytic region, Aug. 15, 1905, *Nash & Taylor 1650* (NY); Mt. La Mine, vicinity of St. Michel de l'Atalaye, Nov. 19, 1925, *Leonard 7229* (NY, US); same locality [leaves intermediate between group 1 and group 2], Nov. 22, 1925, *Leonard 7351* (G, US).

A comparison of the diagnoses of the three possible parent species and the two groups of putative hybrids will show a certain connection of the latter for *P. subsessilis,* and a more pronounced affinity with *P. rubra* than with *P. obtusa,* evidenced in group 2 by the large leaves of outline so resembling that characteristic of *P. rubra* that even Urban called attention to it (Symb. Ant. 3: 337. 1902, sub *P. biglandulosa).* An additional indication of hybridity involving *P. rubra* may be the occasional description of the flower color by collectors as "yel-

low at the base,'' and "buds purplish without,'' as well as the occasional pubescence of the inflorescence.

On the other hand, were *P. obtusa* involved in hybridization with *P. subsessilis,* one would expect the leaves of the hybrids to be more nearly the size of the former's, both with respect to the lamina and the petiole, and to have a heavier texture, together with a tendency toward an obovate outline. *P. obtusa* might also be expected to impart to its progeny flower buds with more nearly longitudinal aestivation of the corolla-lobes, and without a tendency toward yellow or purplish coloration of the corolla. Upon the basis of the foregoing considerations, obviously fallible without experimental evidence most difficult at the moment to obtain, a fair degree of confidence may be placed in ascribing putative hybridity to the following segregate species:

Plumeria **rubra** L. × P. **subsessilis** A. DC. (?)
Plumieria biglandulosa Urb. Symb. Ant. **3**: 337. 1902.
Plumieria Paulinae Urb. Symb. Ant. **3**: 336. 1902.
Plumieria stenopetala Urb. Symb. Ant. **3**: 335. 1902.
Plumeria stenopetala Urb. var. *angustissima* Urb. Arkiv f. Bot. **17**[7]: 50. 1921.
Plumeria longiflora Urb. & Ekm. in Urb. Arkiv f. Bot. **20A**[5]: 38. 1926.
Plumeria discolor Urb. & Ekm. in Urb. Arkiv f. Bot. **20A**[5]: 36. 1926.
Plumeria trouinensis Urb. & Ekm. in Urb. Arkiv f. Bot. **20A**[5]: 37. 1926.

At this point, attention should be called to the fact that at least some of the putative hybrids of *P. rubra* × *P. subsessilis* are fertile, producing follicles containing perfectly formed seeds.

Hybrids found in nature very rarely range themselves in a position exactly intermediate between either parent; therefore it is not surprising to find that the putative hybrids of *P. rubra* × *P. subsessilis* may be divided roughly into two groups, favoring one or the other parent in gross habit. The herbarium doubtless has its difficulties for the detection of hybridization,

but the methods of systematists who may be interested in the origins of their exsiccatae frequently have been confirmed by experimental geneticists and cytologists (cf. Clausen, J. Cytological evidence for the hybrid origin of *Pentstemon neotericus* Keck. Hereditas **18**: 65–76. 1933; Anderson, E. An experimental study of hybridization in the genus *Apocynum*. Ann. Mo. Bot. Gard. **23**: 159–168. 1936).

At least two reasons present themselves for the absence of hybrids from the Dominican Republic in sharp contrast to the abundance from Haiti. Collections from the former, as a whole, are far fewer than from Haiti. Hybrids may very well exist undetected under such conditions. Another consideration of possible importance, however, is the fact that although Haiti is approximately one half the area of the Dominican Republic, the population is nearly three times greater. *P. subsessilis* is indigenous to both republics. *P. rubra,* on the other hand, is introduced, and the opportunities of hybridization might well be greater in a country of high population than in one more sparsely settled. Several botanists have noticed the abundance of plant hybrids in regions disturbed by the human population (cf. Wiegand, K. M. A taxonomist's experience with hybrids in the wild. Science n.s. **81**: 161–166. 1935; Anderson, E. Hybridization in American Tradescantias. Ann. Mo. Bot. Gard. **23**: 511–525. 1936).

EXCLUDED OR DUBIOUS SPECIES

(Literature of the western hemisphere only)

Plumeria ambigua Muell.-Arg. in Mart. Fl. Bras. 6^1: 37. 1860 = HIMATANTHUS PHAGEDAENICA (Mart.) Woodson, Ann. Mo. Bot. Gard. **25**: 199. 1938 *(Plumeria phagedaenica* Mart. in Spix & Mart. Reise Bras. **3**: 1128. 1831).

Plumeria angustifolia Aubl. Pl. Guyan. 259. 1775, nom. subnud. Perhaps equivalent to *P. rubra* L.

Plumeria articulata Vahl, Eclog. **2**: 20. 1798 = HIMATANTHUS ARTICULATA (Vahl) Woodson, Ann. Mo. Bot. Gard. **25**: 196. 1938.

Plumeria attenuata Benth. in Hook. Jour. Bot. **3**: 245. 1841 =

HIMATANTHUS ATTENUATA (Benth.) Woodson, Ann. Mo. Bot. Gard. **25**: 197. 1938.

Plumeria bracteata A. DC. in DC. Prodr. **8**: 394. 1844 = HIMATANTHUS BRACTEATA (A. DC.) Woodson, Ann. Mo. Bot. Gard. **25**: 200. 1938.

Plumeria cuspidata Glaziou, Bull. Soc. Bot. Fr. **52**: Mem. 3e. 451. 1905. nom. subnud. The specimen is in fruit only, and certainly is not apocynaceous.

Plumeria drastica Mart. in Spix & Mart. Reise Bras. **2**: 547. 1828 = HIMATANTHUS ARTICULATA (Vahl) Woodson, Ann. Mo. Bot. Gard. **25**: 196. 1938 (*Plumeria articulata* Vahl, Eclog. Amer. 2: 20. 1798).

Plumeria fallax Muell.-Arg. in Mart. Fl. Bras. **6**^{1}: 38. 1860 = HIMATANTHUS PHAGEDAENICA (Mart.) Woodson, Ann. Mo. Bot. Gard. **25**: 199. 1938 (*Plumeria phagedaenica* Mart. in Spix & Mart. Reise Bras. **3**: 1128. 1831) in part; HIMATANTHUS ARTICULATA (Vahl) Woodson, Ann. Mo. Bot. Gard. **25**: 196. 1938 (*Plumeria articulata* Vahl, Eclog. Amer. 2: 20. 1798) in part.

Plumeria floribunda Muell.-Arg. in Mart. Fl. Bras. **6**^{1}: 40. 1860 = HIMATANTHUS SUCUUBA (Spruce) Woodson, Ann. Mo. Bot. Gard. **25**: 198. 1938 (*Plumeria Sucuuba* Spruce, ex Muell.-Arg. in Mart. Fl. Bras. **6**^{1}: 40. 1860) in part; HIMATANTHUS PHAGEDAENICA (Mart.) Woodson, Ann. Mo. Bot. Gard. **25**: 199. 1938 (*Plumeria phagedaenica* Mart. in Spix & Mart. Reise Bras. **3**: 1128. 1831) in part.

Plumeria Hilariana Muell.-Arg. in Mart. Fl. Bras. **6**^{1}: 39. 1860 = HIMATANTHUS OBOVATA (Muell.-Arg.) Woodson var. PUBERULA (Muell.-Arg.) Woodson, Ann. Mo. Bot. Gard. **25**: 201. 1938 (*Plumeria puberula* Muell.-Arg. in Mart. Fl. Bras. **6**^{1}: 39. 1860).

Plumeria lancifolia Muell.-Arg. in Mart. Fl. Bras. **6**^{1}: 41. 1860 = HIMATANTHUS LANCIFOLIA (Muell.-Arg.) Woodson, Ann. Mo. Bot. Gard. **25**: 200. 1938.

Plumiera latifolia Pilger, in Engl. Bot. Jahrb. **30**: 183. 1901 = HIMATANTHUS OBOVATA (Muell.-Arg.) Woodson var. PUBERULA (Muell.-Arg.) Woodson, Ann. Mo. Bot. Gard. **25**: 201. 1938 (*Plumeria puberula* Muell.-Arg. in Mart. Fl. Bras. **6**^{1}: 39. 1860).

Plumeria Martii Muell.-Arg. in Mart. Fl. Bras. 6^1: 37. 1860 = HIMATANTHUS PHAGEDAENICA (Mart.) Woodson, Ann. Mo. Bot. Gard. **25**: 199. 1938 *(Plumeria phagedaenica* Mart. in Spix & Mart. Reise Bras. **3**: 1128. 1831).

Plumeria microcalyx Standl. Field Mus. Publ. Bot. **4**: 254. 1929 = HIMATANTHUS ARTICULATA (Vahl) Woodson, Ann. Mo. Bot. Gard. **25**: 196. 1938 *(Plumeria articulata* Vahl, Eclog. Amer. 2: 20. 1798).

Plumeria obovata Muell.-Arg. in Mart. Fl. Bras. 6^1: 40. 1860 = HIMATANTHUS OBOVATA (Muell.-Arg.) Woodson, Ann. Mo. Bot. Gard. **25**: 201. 1938.

Plumeria oligoneura Malme, Arkiv f. Bot. **21A**^{6}: 6. 1927. See note, p. 201.

Plumeria phagedaenica Mart. in Spix & Mart. Reise Bras. **3**: 1128. 1831 = HIMATANTHUS PHAGEDAENICA (Mart.) Woodson, Ann. Mo. Bot. Gard. **25**: 199. 1938.

Plumeria puberula Muell.-Arg. in Mart. Fl. Bras. 6^1: 39. 1860 = HIMATANTHUS OBOVATA (Muell.-Arg.) Woodson var. PUBERULA (Muell.-Arg.) Woodson, Ann. Mo. Bot. Gard. **25**: 201. 1938.

Plumeria revoluta Huber, Bull. Soc. Bot. Genève II. **6**: 200. 1915 = HIMATANTHUS BRACTEATA (A. DC.) Woodson, Ann. Mo. Bot. Gard. **25**: 200. 1938 *(Plumeria bracteata* A. DC. in DC. Prodr. **8**: 394. 1844).

Plumeria speciosa Muell.-Arg. in Mart. Fl. Bras. 6^1: 36. 1860 = HIMATANTHUS PHAGEDAENICA (Mart.) Woodson, Ann. Mo. Bot. Gard. **25**: 199. 1938 *(Plumeria phagedaenica* Mart. in Spix & Mart. Reise Bras. **3**: 1128. 1831).

Plumeria Sucuuba Spruce, ex Muell.-Arg. in Mart. Fl. Bras. 6^1: 40. 1860 = HIMATANTHUS SUCUUBA (Spruce) Woodson, Ann. Mo. Bot. Gard. **25**: 198. 1938.

Plumeria tarapotensis K. Sch. ex Mgf. Notizblatt **11**: 339. 1932 = HIMATANTHUS SUCUUBA (Spruce) Woodson, Ann. Mo. Bot. Gard. **25**: 198. 1938 *(Plumeria Sucuuba* Spruce, ex Muell.-Arg. in Mart. Fl. Bras. 6^1: 40. 1860).

Plumeria velutina Muell.-Arg. in Mart. Fl. Bras. 6^1: 38. 1860 = HIMATANTHUS OBOVATA (Muell.-Arg.) Woodson var. PU-

BERULA (Muell.-Arg.) Woodson, Ann. Mo. Bot. Gard. **25**: 201. 1938 (*Plumeria puberula* Muell.-Arg. in Mart. Fl. Bras. **6**^{1}: 39. 1860).

Plumeria Warmingii Muell.-Arg. Kjoeb. Vidensk. Meddel. p. 99. 1869 = HIMATANTHUS OBOVATA (Muell.-Arg.) Woodson, Ann. Mo. Bot. Gard. **25**: 201. 1938 (*Plumeria obovata* Muell.-Arg. in Mart. Fl. Bras. **6**^{1}: 40. 1860).

A REVISION OF THE GENUS LOMATIUM

MILDRED E. MATHIAS
Research Associate, University of California

The genus *Lomatium* was described by Rafinesque[1] with a single species, *L. villosum,* which must accordingly be taken as the type of the genus. *Lomatium villosum* was based on a plant collected by Bradbury on the upper Missouri, and characterized as having white flowers and being entirely villous. It so happens that there are only three species of this genus in the region where Bradbury collected, namely *L. foeniculaceum, L. daucifolium,* and *L. orientale. L. orientale* is the only species of the three having white flowers, but the plants never are entirely villous. Although Bradbury collected specimens of *L. orientale,* it seems highly improbable that Rafinesque would term the plants villous. It is more probable that in the dried specimens the flower color was misinterpreted, and that the plant from which he drew his description was the yellow-flowered, villous *L. foeniculaceum (Peucedanum villosum* of Nuttall), the common species in the region on the upper Missouri visited by Bradbury.

In 1820 Sprengel[2] proposed the name *Cogswellia* in place of *Lomatium* Raf. which he considered to be antedated by *Lomatia* R. Br. (Proteaceae). Recent workers have used both *Cogswellia* and *Lomatium* in dealing with numerous species erroneously considered by numerous writers[3] to be congeneric with the European *Peucedanum* L.

The name *Lomatium* was not used by American authors until 1900, when Coulter & Rose[4] adopted it in their monograph

[1] Raf. Journ. Phys. 89: 101. 1819.
[2] Spreng. in Linn. Syst. Veg. ed. Roem. & Schult. 6: XLVIII. 1820.
[3] cf. S. Wats. Proc. Am. Acad. 11: 141. 1876, footnote.
[4] Coult. & Rose, Contr. U. S. Nat. Herb. 7: 204. 1900.

Issued December 27, 1937.

of the Umbelliferae. In 1908 Jones[5] adopted the generic name *Cogswellia,* considering *Lomatium* as a homonym of *Lomatia* R. Br. Coulter and Rose[6] accepted the latter viewpoint in a later publication.

The name *Lomatium* Raf. was reinstated in 1918 by Macbride,[7] who drew attention to the fact that *Lomatia* R. Br. (Proteaceae) and *Lomatium* Raf. (Umbelliferae) cannot properly be considered as homonyms, and that the retention of both is provided for in Article 57 of the International Rules of Botanical Nomenclature (Article 70, third edition) which reads in part: "When the difference between two names, especially two generic names, lies in the termination, these names are to be regarded as distinct even though differing by one letter only."

Since the monograph by Coulter and Rose,[8] there has been no complete revision of the species of this complex and interesting genus. Numerous new species have been described, and the genus has been treated variously by authors of local manuals. It is still considered by most workers as one of the most difficult, because least understood, of the North American genera of Umbelliferae. It is in fact the largest genus of the family occurring in the United States. In distribution it is limited to the western United States, adjacent Canada, and Mexico, extending as far north as central Saskatchewan and southward into northern Sonora and Lower California. Its eastern limits apparently are from western Minnesota to Missouri. The greatest number of species are found in the Pacific coast states from the Columbia River area in eastern Washington to central California. In this area the genus has reached its greatest diversity.

The writer has had the opportunity of making field studies throughout most of this area. Herbarium material has been studied in all the larger herbaria in the United States and in many private collections. Whenever necessary, photographs

[5] M. E. Jones, Contr. Western Bot. 12: 30. 1908.
[6] Coult. & Rose, Contr. U. S. Nat. Herb. 12: 448. 1909.
[7] Macbr. Contr. Gray Herb. n.s. 53: 15. 1918.
[8] Coult. & Rose, *loc. cit.* 1900.

of critical specimens have been obtained from European herbaria.

The study of this genus was suggested by Dr. J. M. Greenman of the Missouri Botanical Garden. The writer wishes to take this opportunity to thank him again for his valuable and experienced advice and assistance, and to thank the curators of the numerous herbaria in which collections have been studied and the many collectors who have contributed material. Without access to a large amount of material this study would have been impossible. Unfortunately there is space in this paper to cite but a small portion of the material examined, and for the widely distributed, well-known species only typical specimens are included.

Flower characters are relatively constant in the genus. Flower color varies from white to purple and yellow. The fruit is always dorsally compressed, with the lateral wings usually well developed. The dorsal ribs are obsolete to filiform, rarely subalate. The oil tubes vary from one to many in the intervals and are rarely obscure. The stylopodium is absent and the disc never inflated. The styles are filiform, deciduous, or persistent. The calyx teeth are usually inconspicuous, especially in the mature fruit.

The plants are mostly low-growing, acaulescent, or caulescent, from a globose tuberous or elongated subfusiform root. The stems may be solitary or many from the base, and are rarely branching above. The leaves, rarely entire in the young plant, are ternately to pinnately or quinately decompound; the leaflets are filiform, sometimes greatly elongated, to suborbicular in outline, with the margins usually entire but sometimes dentate. The plants are glabrous to entirely or partially villous-tomentose. The involucre may be present or absent and is usually inconspicuous. The involucel bracts are rarely absent and vary to conspicuous, ovate-oblong, or obovate bractlets. The umbel is always compound and usually spreading with long rays. The pedicels are rarely less than 2 mm. long.

In this paper the characters of peduncle, ray, and pedicel length refer to the fruiting condition when these parts have reached their maximum length.

Lomatium Raf. Journ. Phys. **89**: 101. 1819.

Cogswellia Spreng. in Linn. Syst. Veg. ed. Roem. & Schult. **6**: XLVIII. 1820.
Euryptera Nutt. in Torr. & Gray, Fl. N. Am. **1**: 629. 1840.
Leibergia Coult. & Rose, Contr. U. S. Nat. Herb. **3**: 575. 1896.
Cynomarathrum Nutt. ex Coulter & Rose, Contr. U. S. Nat. Herb. **7**: 244. 1900.
"*Cogswellia* Raf." acc. to Coult. & Nels. Man. Bot. Centr. Rocky Mts. 362. 1909, in err.
Peucedanum of American authors, not of Linn.

Usually low, herbaceous, acaulescent or short-caulescent, glabrous or pubescent perennials, from globose tubers to long, thickened, subfusiform roots. Leaves petiolate, thin to subcoriaceous, ternately, pinnately, or quinately decompound; ultimate leaf divisions few to many, suborbicular to elongated, filiform, crowded or remote; petioles broadened into sheaths at least toward the base. Inflorescence a compound umbel, usually spreading; peduncles equalling to exceeding the leaves; involucre mostly absent, never conspicuous; involucel bracts rarely absent, filiform to obovate, foliaceous to subscarious, distinct or connate; central umbellets and central flowers usually sterile, short-rayed, and short-pedicellate; flowers greenish-white, purple, or yellow; calyx teeth small; petals ovate to obovate with a narrowed, inflexed, acute to acuminate tip; stylopodium lacking. Fruit ovate to linear, flattened dorsally; lateral wings present; dorsal wings absent or filiform; wings thin; oil tubes small, one to many in the intervals, rarely obscure, two to several on the commissural side; carpophore divided to the base, usually persistent.

Type species: *Lomatium villosum* Raf. Jour. Phys. **89**: 101. 1819 (L. foeniculaceum (Nutt.) Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 222. 1900).

KEY TO THE SPECIES

A. Peduncles not enlarged at the apex.
B. Fruit more or less deeply emarginate at each end, the wings distinct on each side of the body; leaflets mostly broad in outline.
C. Leaf segments not pinnatifid, merely toothed or sometimes 3-lobed.
E. Leaves 1–2-ternate; wings thickened, much broader than the body, oil tubes solitary in the intervals; plants of southern California ....1. *L. lucidum*

EE. Leaves ternate-pinnate; wings thin, about equalling to broader than the body; oil tubes 1–3 in the intervals.
I. Fruit broadly elliptical; plants mostly low, of Napa and Lake counties, California..............................2. *L. repostum*
II. Fruit suborbicular; plants mostly taller, of southern Oregon and adjacent California..............................3. *L. Howellii*
CC. Leaf segments pinnatifid, usually incised.
F. Leaf blades large, longer than the petioles; fruit 12–15 mm. long; plants of San Nicolas Island, California.............5. *L. insulare*
FF. Leaf blades smaller, mostly equalling or shorter than the petioles; fruit 7–10 mm. long; plants of the California mainland.
J. Leaf segments acerose-tipped; wings less than half the width of the body; plants of the eastern slopes of the Sierra Nevada Mts., Inyo Co., California.........................6. *L. rigidum*
JJ. Leaf segments not acerose-tipped; wings broader than the body; plants of Monterey and San Luis Obispo counties, California.
O. Foliage green; fruiting rays 0.8–2.5 cm. long, pedicels 3–6 mm. long..................................4. *L. parvifolium*
OO. Foliage pale; fruiting rays 3–6.5 cm. long, pedicels 7–17 mm. long......................4a. *L. parvifolium* var. *pallidum*
BB. Fruit not emarginate or scarcely so, the wings more or less joined above and below the body; leaflets mostly narrow.
D. Plants mostly low, from globose or somewhat elongated tubers; leaves mostly small.
G. Ovaries and fruit variously pubescent.
K. Flowers white or purple; involucel bracts absent or setaceous.... ....7. *L. Gormani*
KK. Flowers yellow; involucel bracts distinct, obovate or connate.
P. Tuber deep-seated, oblong; involucel bracts united nearly to the apex; fruit ovate, sessile or subsessile; oil tubes obscure.... ....14. *L. Watsoni*
PP. Tuber globose or occasionally elongated; involucel bracts distinct, obovate, scarious-margined; fruit oblong, pedicels about 2–4 mm. long; oil tubes prominent............17. *L. Cous*
GG. Ovaries and fruit glabrous.
L. Involucel bracts absent or inconspicuous.
Q. Plants caulescent, alternately branched above; flowers yellow; fruiting pedicels 4–8 mm. long................16. *L. ambiguum*
QQ. Plants acaulescent or short-caulescent, not branched above; flowers white; fruit subsessile....................8. *L. Piperi*
LL. Involucel bracts present, conspicuous.
R. Leaflets few; fruit linear, 1–1.5 mm. broad, constricted toward the apex, the wings almost obsolete...........9. *L. orogenioides*
RR. Leaflets several to many; fruit ovate to linear-oblong, 2–6 mm. broad, not constricted above, the wings obvious.
W. Involucel bracts linear to linear-lanceolate, sometimes more or less connate.
f. Leaflets filiform to linear, mostly elongated, up to 8 cm. long; flowers white or yellow.

u. Flowers yellow; oil tubes solitary in the intervals...... ....15. *L. leptocarpum*

uu. Flowers white; oil tubes several in the intervals.

o. Involucel bracts distinct; fruiting pedicels lax, 6–17 mm. long...........................10. *L. farinosum*

oo. Involucel bracts more or less connate; fruiting pedicels suberect, 2–5 mm. long..................11. *L. Geyeri*

ff. Leaflets short-linear, up to 5 mm. long; flowers white.

w. Umbels 2–5-rayed, fruiting rays 1–2 cm. long, pedicels 3–4 mm. long; fruit ovate, 5 mm. long..12. *L. Hendersoni*

ww. Umbels 12–17-rayed, fruiting rays 2.7–5.5 cm. long, pedicels 8–12 mm. long; fruit linear-oblong, 7–10 mm. long..................................13. *L. Canbyi*

WW. Involucel bracts obovate, sometimes connate.

g. Plants acaulescent; oil tubes 2–4 in the intervals........ ....18. *L. montanum*

gg. Plants caulescent; oil tubes solitary in the intervals...... ....19. *L. circumdatum*

DD. Plants usually stouter, from more or less thickened, elongated taproots, sometimes with a very deep-seated tuber.

H. Leaves decompound, dissected into numerous small segments.

M. Ovaries and young (sometimes mature) fruit variously pubescent or roughened.

S. Involucel bracts oblanceolate to obovate.

X. Umbels 5–13-rayed; wings mostly broader than the body.

h. Mature fruit glabrous....................21. *L. utriculatum*

hh. Mature fruit papillate....21a. *L. utriculatum* var. *papillatum*

XX. Umbels 14–25-rayed; wings equalling the body.......... ....20. *L. vaginatum*

SS. Involucel bracts mostly linear, never obovate, sometimes reduced to a sheath.

Y. Young fruit more or less granulate-roughened; plants with one or more upper stem leaves.

i. Petioles with a conspicuous white scarious margin; plants of the northern Rocky Mts...................36. *L. Sandbergii*

ii. Petioles without a conspicuous white scarious margin; plants of Plumas Co., California......25c. *L. Plummerae* var. *Helleri*

YY. Young fruit variously pubescent, not granulate-roughened; plants acaulescent or with stem leaves from near the base.

j. Involucel bracts with a conspicuous scarious margin, never tomentose nor villous.....................24. *L. nevadense*

jj. Involucel bracts not conspicuously scarious-margined, more or less tomentose or villous.

x. Plants acaulescent, usually low, up to 3, rarely 5, dm. tall.

y. Plants more or less villous throughout; petioles shorter than the leaf blades.

p. Petioles 1–2.5 cm. long, usually sheathing throughout; flowers yellow, tinged with purple; plants of the Great Basin..................26. *L. MacDougali*

pp. Petioles 3–8 cm. long, sheathing about to the middle; flowers yellow; plants of the Great Plains ....28. *L. foeniculaceum*

yy. Plants hoary-pubescent, never villous; petioles longer than the leaf blades; plants of the deserts of California and adjacent Nevada.........32. *L. mohavense*

xx. Plants short-caulescent, rarely acaulescent, mostly taller, up to 5 dm. tall.

(d). Petals glabrous; fruit narrowly oblong, sparingly pubescent with long hairs........34. *L. macrocarpum*

(dd). Petals tomentose; fruit ovate-oblong to orbicular, densely pubescent.

(m). Pedicels mostly longer than the mature fruit; wings broader than the body, membranous, thinly pubescent to glabrate....31. *L. dasycarpum*

(mm). Pedicels mostly shorter than the mature fruit; wings narrower than to equalling the body, somewhat thickened, tomentose..33. *L. tomentosum*

MM. Ovaries and fruit glabrous.

T. Involucel bracts absent.

Z. Foliage and peduncles pubescent; umbels 2–7-rayed........ ....38. *L. Engelmannii*

ZZ. Foliage and peduncles glabrous, rarely scaberulent; umbels 5–16-rayed.

k. Flowers white; fruiting pedicels 6–10 mm. long; plants of Mariposa Co., California..................35. *L. Congdoni*

kk. Flowers creamy-white to yellow; fruiting pedicels less than 6 mm. long except in *39a*.

z. Leaf segments filiform, 3–8 mm. long; plants of the southern Sierra Nevada Mts., California............ ....37. *L. Torreyi*

zz. Leaf segments ovate, 1–2 mm. long; plants of the northern coast ranges and Cascades, British Columbia to Oregon.

q. Flowers creamy-white; pedicels 1–6 mm. long........ ....39. *L. angustatum*

qq. Flowers lemon-yellow; pedicels 8–16 mm. long...... ....39a. *L. angustatum* var. *flavum*

TT. Involucel bracts present.

a. Involucel bracts obovate, sometimes connate.

m. Plants usually with several stem leaves, pilose...22. *L. Vaseyi*

mm. Plants without or with one stem leaf, glabrous to pubescent.

a. Plants glabrous or slightly pubescent; flowers yellow.

r. Plants caespitose; leaflets crowded; plants of montane Montana to Oregon..................18. *L. montanum*

rr. Plants not caespitose; leaflets distinct; plants not montane, of the coast ranges, California.

(e). Wing margins smooth............23. *L. caruifolium*

(ee). Wing margins denticulate....................
............23a. *L. caruifolium* var. *denticulatum*

aa. Plants scaberulent to densely pubescent; flowers white.

s. Plants soft-puberulent; involucel bracts distinct; fruiting rays subequal; plants of the Great Plains and eastern foothills of the Rocky Mts.......30. *L. orientale*

ss. Plants pubescent; involucel bracts connate, sometimes reduced; fruiting rays unequal; plants of the Great Basin.

(f). Wings narrower than the body, dorsal ribs inconspicuous............24a. *L. nevadense* var. *Parishii*

(ff). Wings broader than the body, dorsal ribs conspicuous.....24b. *L. nevadense* var. *pseudorientale*

aa. Involucel bracts filiform to linear-lanceolate, never obovate.

n. Involucel bracts more or less tomentose or villous.

b. Flowers white; involucel bracts distinct, equalling to greatly exceeding the flowers.

t. Wings narrower than to equalling the body..........
..................................34. *L. macrocarpum*

tt. Wings broader than the body......................
..................34a. *L. macrocarpum* var. *ellipticum*

bb. Flowers yellow; involucel bracts connate to above the middle, equalling the flowers..........29. *L. daucifolium*

nn. Involucel bracts glabrous or minutely and sparingly roughened.

c. Plants more or less pubescent.

u. Flowers yellow; plants mostly low, less than 3 dm. tall; plants of the Great Basin.

(g). Involucel bracts distinct; fruiting pedicels 5–10 mm. long; wings about half the width of the body; oil tubes several in the intervals......
............................27. *L. juniperinum*

(gg). Involucel bracts connate at the base; fruiting pedicels 4–6, rarely 10, mm. long; wings nearly as broad as the body; oil tubes solitary in the intervals.

(n). Fruit oblong to oblong-ovate, 9–13 mm. long
................25a. *L. Plummerae* var. *Sonnei*

(nn). Fruit ovate, 8 mm. long....................
.............25b. *L. Plummerae* var. *Austinae*

uu. Flowers white; plants usually taller, up to 4.5 dm. tall.

(h). Plants soft-puberulent; rays subequal; plants of the Great Plains and eastern foothills of the Rocky Mts......................30. *L. orientale*

(hh). Plants pubescent; rays unequal; plants of the Great Basin.

(o). Wings narrower than the body, dorsal ribs inconspicuous......24a. *L. nevadense* var. *Parishii*

(oo). Wings broader than the body, dorsal ribs conspicuous...24b. *L. nevadense* var. *pseudorientale*

cc. Plants glabrous or occasionally slightly scaberulent, never pubescent; flowers yellow or purple.

w. Plants acaulescent or with a pseudoscape.

(i). Leaflets filiform, mostly elongated, up to 4.5 cm. long; flowers purple; plants of Napa Co., California..........23c. *L. caruifolium* var. *purpureum*

(ii). Leaflets linear to ovate-oblong, rarely filiform, usually shorter, up to 11 mm. long; flowers yellow; plants of the Great Basin.

(p). Plants up to 6.1 dm. tall; leaves broadly obovate, the blades large, 10.5 cm. or longer; involucel bracts shorter than the flowers...... ....40. *L. Grayi*

(pp). Plants low, up to 3 dm. tall; leaves ovate to oblong, the blades smaller, less than 10.5 cm. long; involucel bracts equalling the flowers.

(r). Leaves minutely papillose above; wings one-half to equalling the body, oil tubes solitary in the intervals............41. *L. serpentinum*

(rr). Leaves glabrous above; wings less than half the width of the body, oil tubes 3–6 in the intervals....................42. *L. Donnellii*

ww. Plants short-caulescent.

(j). Leaflets remote, mostly elongated, up to 45 mm. long; plants of the western foothills of the Sierra Nevada Mts., California.............. ....23b. *L. caruifolium* var. *marginatum*

(jj). Leaflets crowded, shorter, up to 11 mm. long.

(q). Petioles entirely sheathing; fruit acute at the apex; plants of east-central California and adjacent Nevada.............25. *L. Plummerae*

(qq). Petioles partially sheathing; fruit rounded at the apex.

(s). Involucel bracts sparingly hispid; oil tubes 3 in the intervals; plants of southwestern Oregon...................43. *L. Nelsonianum*

(ss). Involucel bracts glabrous; oil tubes solitary in the intervals; plants of the Great Basin ....40. *L. Grayi*

HH. Leaves with mostly few divisions, ternately or pinnately divided, the leaflets mostly remote.

N. Plants acaulescent or short-caulescent; leaves 1–2-pinnate, rarely 3-pinnate.

U. Foliage variously pubescent.

b. Leaves entirely pubescent.

o. Ovaries and fruit pubescent................45. *L. oreganum*

oo. Ovaries and fruit glabrous.
 d. Leaves pinnate; plants less than 1 dm. tall..44. *L. minimum*
 dd. Leaves mostly 2–3-pinnate; plants 1 dm. or more tall.
 y. Pedicels 6–17 mm. long; wings equalling to broader than the body; plants of southwestern Colorado.... ....47. *L. Eastwoodae*
 yy. Pedicels (2?)–9 mm. long; wings less than half the width of the body; plants of southwestern Utah.... ....48. *L. scabrum*
bb. Leaves glabrous except for ciliolate margins....49. *L. ciliolatum*
UU. Foliage glabrous.
 c. Leaves 2–3-pinnate.
 p. Plants short-caulescent, 1.2–2.5 dm. tall; involucel bracts foliaceous, ovate-lanceolate; fruit ovate, 5–8 mm. long ....50. *L. concinnum*
 pp. Plants acaulescent, 1.5–5 dm. tall; involucel bracts linear; fruit oblong, 7–13 mm. long.
 e. Peduncles equalling to somewhat exceeding the leaves; pedicels 10–17 mm. long; wings equalling or somewhat broader than the body.....................51. *L. Parryi*
 ee. Peduncles usually greatly exceeding the leaves; pedicels 3–7 mm. long; wings about half the width of the body.
 z. Leaflets remote, 10–50 mm. long; plants tall, stout.... ....52. *L. Nuttallii*
 zz. Leaflets crowded, 1–4 mm. long; plants lower, slender.
 (k). Leaves bipinnate, pinnae few, remote.......... ....40a. *L. Grayi* var. *depauperatum*
 (kk). Leaves tripinnate, pinnae many, crowded...... ....53. *L. Hallii*
 cc. Leaves pinnate, rarely bipinnate.
 q. Plants less than 1 dm. tall; leaf blades less than 2.5 cm. long.
 f. Plants acaulescent, 1–3.5 cm. tall; rays 3–12 mm. long; plants of southwestern Utah..............44. *L. minimum*
 ff. Plants caulescent with one stem leaf, 5–8 cm. tall; rays 1.5–2 mm. long; plants of the Wallowa Mts., Oregon ....46. *L. Greenmanii*
 qq. Plants more than 1 dm. tall; leaf blades more than 2.5 cm. long.
 j. Leaflets ovate, crowded; fruit 13–16 mm. long; plants of high Cascade Mts., Oregon.............54. *L. Martindalei*
 jj. Leaflets linear to lanceolate; remote; fruit less than 12 mm. long; plants of the Great Basin mountains.
 (a). Umbels 3–6-rayed; pedicels 4–10 mm. long........ ....52a. *L. Nuttallii var. alpinum*
 (aa). Umbels 4–11-rayed; pedicels 1–4 mm. long.
 (l). Leaflets lanceolate, 2–6 mm. broad; central rays sterile..........................55. *L. latilobum*

(ll). Leaflets linear, about 1 mm. broad; central rays fertile........................56. *L. megarrhizum*

NN. Plants mostly caulescent, tall; leaves ternate-pinnately or quinate-pinnately divided.

V. Plants variously pubescent.

d. Ovaries and young fruit glabrous.

r. Leaflets linear; fruit 7–14 mm. long.

k. Leaves biternate; involucel bracts shorter than the pedicels; fruit 7–14 mm. broad, the wings equalling to broader than the body....................57. *L. simplex*

kk. Leaves ternate-pinnate; involucel bracts equalling the pedicels; fruit 3–5 mm. broad, the wings narrower than the body............................58. *L. triternatum*

rr. Leaflets ovate-lanceolate to obovate; fruit 13–22 mm. long ....58a. *L. triternatum* var. *anomalum*

dd. Ovaries and young fruit pubescent.

s. Leaves biternate; wings equalling to broader than the body ....57a. *L. simplex* var. *leptophyllum*

ss. Leaves ternate-pinnate; wings narrower than the body.

m. Leaflets elongated, up to 14.5 cm. long.

(b). Leaflets linear; involucel bracts few or absent.... ....58d. *L. triternatum* var. *alatum*

(bb). Leaflets linear to ovate-lanceolate; involucel bracts several, equalling the pedicels................. ....58b. *L. triternatum* var. *macrocarpum*

mm. Leaflets shorter, up to 2.2 cm. long.

(c). Plants low, up to 3.5 dm. tall; pedicels 1–4 mm. long; fruit 6–8 mm. long..................... ....58c. *L. triternatum* var. *brevifolium*

(cc). Plants 9–21 dm. tall; pedicels 6–17 mm. long; fruit 24–28 mm. long....61a. *L. Suksdorfii* var. *Thompsonii*

VV. Plants glabrous or rarely slightly scaberulent, never pubescent.

e. Plants 9–21 dm. tall; fruit 15–32 mm. long......61. *L. Suksdorfii*

ee. Plants 1–5.6 dm. tall; fruit 6–13 mm. long.

t. Stems simple; leaflets filiform to linear; fruit never reflexed.

n. Plants 1–2.2 dm. tall; leaflets few; involucel bracts present; fruit 11–13 mm. long................59. *L. Cusickii*

nn. Plants 2.5–3.7 dm. tall; leaflets many; involucel bracts usually absent; fruits 6–10 mm. long....60. *L. laevigatum*

tt. Stems few-branched; leaflets linear-lanceolate to oblanceolate; fruit usually reflexed..............62. *L. Brandegei*

AA. Peduncles swollen at the apex...........................63. *L. nudicaule*

1. **Lomatium lucidum** (Nutt.) Jepson, Econ. Pl. Calif. 119. 1924; Madroño 1: 149. 1924.

Euryptera lucida Nutt. ex Torr. & Gray, Fl. N. Am. 1: 629. 1840.
Peucedanum Euryptera Gray, Proc. Am. Acad. 7: 348. 1868.

P. Hassei Coult. & Rose, Bot. Gaz. 14: 276. 1889.
Euryptera Hassei Coult. & Rose, Contr. U. S. Nat. Herb. 7: 242. 1900.
Cogswellia lucida (Nutt.) Jones, Contr. Western Bot. 12: 31. 1908.
C. Hassei (Coult. & Rose) Jones, Contr. Western Bot. 12: 31. 1908.

Plants short-caulescent, 2.6–5 dm. tall, glabrous, from a long slender tap-root; leaves ovate-oblong to obovate, the blades 4.5–9 cm. long, 1–2-ternate, the leaflets deltoid to cuneate, 15–70 mm. long, 10–65 mm. broad, entire or 3-lobed, regularly and sharply dentate, the petioles 2.5–14 cm. long, sheathing below; fruiting peduncles exceeding the leaves, stout; umbels 10–20-rayed, the fruiting rays 2–8.5 cm. long, spreading; involucel bracts linear-lanceolate, acuminate, distinct or connate below, about equalling the yellow flowers; umbellets about 20-flowered, the fruiting pedicels 7–17 mm. long; fruit suborbicular to broadly elliptical, 6–15 mm. long, 5–15 mm. broad, emarginate especially at the base, the wings thick, broader than the body, the oil tubes solitary in the intervals, 2–4 on the commissure.

TYPE: *Nuttall,* "woods of San Diego," California (Ph).[1]

DISTRIBUTION: Coast ranges, southern California.

TYPICAL SPECIMENS: CALIFORNIA: foothills of Sierra Madre, Los Angeles Co., *Hasse* (M, NY, UC, US TYPE of *P. Hassei);* open rocky ridges, S. Fork, La Tuna Canyon, Verdugo Range, Los Angeles Co., *Ewan 4173* (M, UC).

---

[1] The following abbreviations have been used in citations to indicate the different herbaria from which material has been obtained for study:

Cal—California Academy of Sciences.
Cl—Herbarium of Ira W. Clokey, South Pasadena, California.
F—Field Museum of Natural History.
G—Gray Herbarium, Harvard University.
Garrett—Herbarium of A. O. Garrett, Salt Lake City, Utah.
Jepson—Herbarium of W. L. Jepson, University of California.
M—Missouri Botanical Garden.
NY—New York Botanical Garden.
Ph—Academy of Natural Sciences, Philadelphia.
Po—Pomona College.
Sta. Barb.—Santa Barbara Museum.
Th—Herbarium of J. W. Thompson, Seattle, Washington.
UC—University of California.
UM—University of Montana.
UO—University of Oregon.
US—United States National Herbarium.

2. **Lomatium repostum** (Jepson) Mathias, comb. nov.

Lomatium lucidum (Nutt.) Jepson var. *repostum* Jepson, Madroño 1: 149. 1924.

Plants acaulescent, 1.5–3.6 dm. tall, glabrous, from a long slender, sometimes branching tap-root; leaves broadly ovate, the blades 5–15 cm. long, 1–2-ternate or ternate-pinnate, the leaflets ovate to subflabellate, 1–4 cm. long, 1–6 cm. broad, regularly and sharply dentate, rarely shallowly lobed, the petioles 3–17 cm. long, shortly sheathing below; peduncles exceeding the leaves; umbels 8–20-rayed, the fruiting rays 3–8 cm. long, spreading; involucel bracts lanceolate, subacuminate, dimidiate, usually connate below, about equalling the greenish-yellow flowers; umbellets about 20-flowered, the fruiting pedicels 8–12 mm. long; fruit broadly elliptical, 10–15 mm. long, 7–12 mm. broad, emarginate at base and apex, the wings thin, about equalling to much broader than the body, the oil tubes 1–3 in the intervals, 4–6 on the commissure.

TYPE: *Jepson*, near Collin's Spr., Vaca Mts., California.

DISTRIBUTION: Inner coast ranges, northern Napa and southern Lake counties, California.

SPECIMENS EXAMINED: CALIFORNIA: East slope Cobb. Mt., *Baker 2287a* (UC); edge of the "Crater Country," Napa Co., *Howell 5358* (UC); trail from Mt. St. Helena Inn to summit of Mt. St. Helena, about 2800 feet, *Mathias 1286* (UC); 7–8 miles from Lower Lake along road to Knoxville, Lake Co., *Mathias 1293, 1319* (UC).

3. **Lomatium Howellii** (Wats.) Jepson, Fl. Calif. 2^1: 637. 1936.

Peucedanum Howellii Wats. Proc. Am. Acad. **20**: 369. 1885.
Euryptera Howellii (Wats.) Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 243. 1900.
Cogswellia Howellii (Wats.) Jones, Contr. Western Bot. **12**: 31. 1908.

Plants acaulescent or short-caulescent, 2.5–4 dm. tall, glabrous, from a long slender branching tap-root; leaves obovate, the blades 4.5–11 cm. long, ternate, then 1–2 pinnate, the leaflets deltoid, 10–25 mm. long, 8–30 mm. broad, entire to 3-lobed, sharply and regularly dentate, the petioles 2.5–7.5 cm. long, sheathing below; peduncles exceeding the leaves; umbels 10–

15-rayed, the fruiting rays spreading, 2.5–5.5 cm. long; involucel bracts several, lanceolate to filiform, about equalling the yellow flowers; umbellets about 20-flowered, the fruiting pedicels 8–12 mm. long; fruit suborbicular, 7–11 mm. long, 7–11 mm. broad, deeply emarginate at base and apex, the wings about equalling the body, the oil tubes 2–3 in the intervals, 9 on the commissure.

TYPE: *Howell*, near Waldo, Josephine Co., Oregon, June 1884 (NY).

DISTRIBUTION: Southwestern Oregon and adjacent California.

SPECIMENS EXAMINED: OREGON: dry rocky ground, 10 miles s. w. of Waldo, Josephine Co., *Thompson 4610* (M); Waldo, *Howell s. n.* (NY), *241, 302* (US), *1153* (M); high hot hillsides, 5 miles down Deer Creek from Selma, *Henderson 5864* (M); 8 mi. south of Waldo, *Piper 6105* (US); dry hillsides of the Siskiyou Mts. on Waldo-Crescent City road, *Cusick 2930a* (US). CALIFORNIA: Sesquete, French Hill, Del Norte Co., *Eastwood 2207* (US).

4. **Lomatium parvifolium** (Hook. & Arn.) Jepson, Madroño 1: 150. 1924; Man. Fl. Pl. Calif. 720. 1925.

Ferula parvifolia Hook. & Arn. Bot. Beechey Voy. 348. 1840.
Peucedanum parvifolium (Hook & Arn.) Torr. & Gray, Fl. N. Am. 1: 628. 1840.
P. californicum Coult. & Rose, Bot. Gaz. 13: 143. 1888, not Nutt. (1840).
Euryptera parvifolia (Hook & Arn.) Coult. & Rose, Contr. U. S. Nat. Herb. 7: 241. 1900.
Cogswellia parvifolia (Hook. & Arn.) K.-Pol. Bull. Soc. Nat. Mosc. 1915, n.s. 29: 177. 1916.

Plants short-caulescent, 1.5–4 dm. tall, glabrous, from a long tap-root; leaves oblong, the blades 3–10 cm. long, ternate (rarely with confluent segments), then 1–2-pinnate, the leaflets lanceolate to cuneate, 8–24 mm. long, 7–15 mm. broad, irregularly and sharply pinnatifid-incised, the petioles 3–15 cm. long, shortly sheathing, purplish; peduncles exceeding the leaves; umbels 8–14-rayed, the fruiting rays subequal, 0.8–2.5 cm. long, spreading; involucel bracts linear-lanceolate to filiform, about equalling the yellow flowers; umbellets 14–20-flowered, the fruiting pedicels 3–6 mm. long; fruit orbicular to oblong, 7–10 mm. long, 6–10 mm. broad, emarginate at base and apex, the wings broader than the body, the oil tubes 1–2, mostly 1, in the dorsal intervals, 2–3 in the lateral intervals, 4–6 on the commissure.

TYPE: *Douglas*, California, probably near Monterey.

DISTRIBUTION: Coastal California, Monterey Co. to San Luis Obispo Co.

TYPICAL SPECIMENS: CALIFORNIA: Del Monte, Monterey Co., *Heller 8420* (M, NY, US); Monterey, *Elmer 4841* (M, NY); Pacific Grove, *Heller 6735* (M, NY, Po, UC, US).

4a. Lomatium parvifolium (Hook. & Arn.) Jepson var. **pallidum** (Coult. & Rose) Jepson, Madroño 1: 150. 1924.

Euryptera pallida Coult. & Rose, Contr. U. S. Nat. Herb. 7: 242. 1900.
Cogswellia pallida (Coult. & Rose) Jones, Contr. Western Bot. 12: 31. 1908.

Similar to the species but the foliage paler; rays 3–6.5 cm. long, the pedicels 7–17 mm. long.

TYPE: *Vasey 232*, Santa Lucia Mts., California, July 1880 (US TYPE, Po).

DISTRIBUTION: San Luis Obispo Co., California.

SPECIMENS EXAMINED: CALIFORNIA: School Canyon, San Luis Obispo Co., *Condit* (UC); Jolon, *T. S. Brandegee* (UC).

5. Lomatium insulare (Eastw.) Munz, Man. So. Calif. Bot. 358. 1935.

Peucedanum insulare Eastw. Proc. Calif. Acad. III, 1: 106. 1898.
Euryptera insularis (Eastw.) Coult. & Rose, Contr. U. S. Nat. Herb. 7: 243. 1900.
Cogswellia insularis (Eastw.) Jones, Contr. Western Bot. 12: 31. 1908.

Plants acaulescent, 1–4(?) dm. tall, glabrous, from a long stout tap-root; leaves ovate to obovate, the blades 6–9 cm. long, 2–3-ternate to biquinate, then pinnate, the leaflets oblong to ovate-oblong, cuneate, 4–14 mm. long, 2–8 mm. broad, irregularly pinnatifid, the petioles 2.5–3 cm. long, sheathing below; fruiting peduncles stout, exceeding the leaves; umbels 15–20-rayed, the fruiting rays subequal, 3.5–8 cm. long, spreading; involucel bracts filiform, exceeding the yellow flowers; umbellets many-flowered, the fruiting pedicels 6–12 mm. long; fruit oblong-ovate, 12–15 mm. long, 7–10 mm. broad, more or less emarginate at base and apex, the wings thick, about equalling the body, the oil tubes 2 in the intervals, 4 on the commissure, rarely 1 in the wings.

TYPE: *Trask*, sand cliffs overhanging briny arroyas, "San Nicholas Island," California, April 1897.

DISTRIBUTION: Known only from the type locality.

SPECIMENS EXAMINED: CALIFORNIA: San Nicolas Island, *Howell 8207* (Cal, M, UC), *Trask 51* (NY, US), *52* (M).

6. Lomatium rigidum (Jones) Jepson, Fl. Calif. 2[1]: 637. 1936.

Cogswellia rigida Jones, Contr. Western Bot. 13: 11. 1910.

Plants acaulescent or short-caulescent, 2.5–4 dm. tall, glabrous, from a cluster of dried leaf sheaths; leaves oblong, the blades 8–12 cm. long, bipinnate (the lower pinnae elongated, appearing ternate), the leaflets ovate to cuneate, 10–20 mm. long, 5–10 mm. broad, sharply pinnatifid, the lobes with acerose or spinulose teeth, the petioles 5–10 cm. long, shortly sheathing below; peduncles exceeding the leaves; umbels 10–20-rayed, the fruiting rays subequal, 2.5–5 cm. long, spreading; involucel bracts conspicuous, lanceolate, acuminate, about equalling the pedicels, reflexed in fruit; flowers yellow, the fruiting pedicels 5–10 mm. long; fruit ovate to oblong, 7–9 mm. long, 5–7 mm. broad, emarginate at base, somewhat rounded at apex, the wings less than one-half the width of the body; oil tubes 3 in the intervals, about 6 on the commissure, the calyx teeth conspicuous especially in the young fruit.

TYPE: *Hall and Chandler 7225*, rocky point north of the town, Big Pine, Inyo Co., California, 4000 feet, 30 May 1906 (Po, Jepson).

DISTRIBUTION: Eastern slopes of the Sierras, Inyo Co., California, 4000 to 10,000 feet.

SPECIMENS EXAMINED: CALIFORNIA: Owen's Valley, *Austin 447a* (US); Andrew's Camp, *Davidson 2738* (US), *K. Brandegee* (Jepson); Big Pine Creek, *Hoffmann* (Sta. Barb.).

7. Lomatium Gormani (Howell) Coult. & Rose, Contr. U. S. Nat. Herb. 7: 208. 1900.

Peucedanum Gormani Howell, Fl. N.W. Am. 1: 252. 1898 (April 1).
P. confusum Piper, Erythea 6: 29. 1898 (April 10).
P. Watsoni Coult. & Rose, in part, acc. to Howell (*loc. cit.* 1898).
Cogswellia Gormani (Howell) Jones, Contr. Western Bot. 12: 33. 1908.

Plants acaulescent, 1–1.5 dm. tall, from a shallow globose tuber up to 2.5 cm. in diameter, covered with fascicles of rootlets; leaves broadly oblong, the blades 3–5.5 cm. long, ternate, then 1–2-pinnate, the leaflets oblong to linear, 2–13 mm. long, about 1 mm. broad, acute, glabrous or sparingly puberulent, the petioles 2.5–7 cm. long, scarious, sheathing throughout; peduncles exceeding the leaves, glabrous or sparingly puberu-

lent; umbels 4–10-rayed, the rays unequal, 0.6–3 cm. long; involucel bracts absent or few, setaceous, scarious-margined, exceeding the pedicels; umbellets 10–20-flowered, the flowers white, the anthers purple, the fruiting pedicels 0.5–3 mm. long; fruit ovate, 5–7 mm. long, 4–5 mm. broad, puberulent, the wings about half the width of the body, the oil tubes 3–4 in the intervals, 4–6 on the commissure.

TYPE: *Howell*, "high hills opposite the Dalles," probably Klickitat Co., Washington.

DISTRIBUTION: Central and southeastern Washington, central Oregon, and Idaho.

TYPICAL SPECIMENS: WASHINGTON: Pullman, *Elmer 73* (M, NY, US). OREGON: hills near Pendleton, *Cusick 3411* (M, NY in part).

A form, **Lomatium Gormani** (Howell) Coult. & Rose forma **purpureum** St. John, Proc. Biol. Soc. Wash. **41**: 196. 1928 (*Cogswellia Gormani* (Howell) Jones forma *purpurea* St. John, Fl. S.E. Wash. & Adj. Ida. 290. 1937) has been described having the petals bright rose-purple. The type collection is by *St. John & Pickett 3714*, rocky hillside, Pullman, Whitman Co., Washington, March 5, 1926.

8. **Lomatium Piperi** Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 211. 1900.

Cogswellia Piperi (Coult. & Rose) Jones, Contr. Western Bot. **12**: 33. 1908.

Plants acaulescent or short-caulescent, 1–2.5 dm. tall, glabrous or with somewhat puberulent foliage, from a small globose, sometimes deep-seated tuber; leaves oblong-ovate, the blades 3–7.5 cm. long, ternate, then tripinnate, the leaflets remote, linear, 3–30 mm. long, 1–2 mm. broad, obtuse to acute, the petioles 3.5–10 cm. long, sheathing below; peduncles exceeding the leaves; umbels 3–20-rayed, the rays unequal, 1–6 cm. long, spreading; involucel bracts absent or few, inconspicuous, linear, shorter than the white flowers; umbellets 6–13-flowered, the anthers purple, the fruiting pedicels absent or less than 2 mm. long; fruit ovate to oblong, 5–9 mm. long, 3–4 mm. broad, the wings half as broad as the body, the oil tubes 1–8 in the intervals, 2–4 on the commissure.

TYPE: *Vasey*, Ellensburg, "Spokane County" (Kittitas Co.), Washington, May 1889 (US).

Distribution: Central Washington to northern California, east to western Idaho.
Typical specimens: washington: Goldendale, Klickitat Co., *Thompson 8188* (M, Th); Maryhill, Klickitat Co., *Thompson 8185* (M, Th). oregon: Lookout Mountain, Crook Co., *Cusick 1687* (M, UC, US). california: Yreka, *Butler 578* (Po, UC), *1115* (Po), *1130* (Po, UC).

9. **Lomatium orogenioides** (Coult. & Rose) Mathias, comb. nov.

Leibergia orogenioides Coult. & Rose, Contr. U. S. Nat. Herb. **3**: 575. 1896.
Cogswellia orogenioides (Coult. & Rose) Jones, Contr. Western Bot. **12**: 33. 1908.

Plants acaulescent, slender, 1–4 dm. tall, from a globose tuber, 6–12 mm. in diameter; leaves oblong, the blades 5–11 cm. long, glabrous, 2–3-ternate, the leaflets few, filiform, 10–45 mm. long, 1–2 mm. broad, acute, minutely apiculate, petioles 2–7 cm. long, usually sheathing about to the middle; peduncles exceeding the leaves; umbels 3–10-rayed, the rays glabrous or sparsely scaberulent, unequal, 3–15 cm. long, ascending; involucel bracts few, linear, acute, exceeding the pedicels; umbellets about 10-flowered, the flowers white, the fruiting pedicels 1–3 mm. long; fruit linear, 8–10 mm. long, 1–1.5 mm. broad, constricted toward the apex, the wings narrow to almost obsolete, the oil tubes small, solitary in the intervals, 2 on the commissure.

Type: *Leiberg 1027*, "Santianne Creek bottoms, Coeur d'Alene Mts., Idaho," 950 m., 24 June 1895 (US).
Distribution: Northern Idaho and northeastern Washington.
Specimens examined: washington: damp low bank of Latah Creek east of Spangle, Spokane Co., *Suksdorf 8645* (Th).

10. **Lomatium farinosum** (Geyer) Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 210. 1900, where the name-bringing synonym is erroneously ascribed to Hook.

Peucedanum farinosum Geyer, ex Hook. Lond. Journ. Bot. **6**: 235. 1847.
Ferula farinosa Geyer, ex Hook. Lond. Journ. Bot. **6**: 235. 1847, nom. nud. in synon.
Cogswellia farinosa (Geyer) Jones, Contr. Western Bot. **12**: 33. 1908.

Plants short-caulescent, 1.5–3 dm. tall, glabrous, from a globose tuber, 1–2 cm. in diameter; leaves oblong, the blades 4–10 cm. long, biternate, the leaflets linear, 1.5–8 cm. long, 1–3 mm. broad, acute, narrowed toward the base, the petioles 1–7 cm.

long, sheathing at the base; peduncles exceeding the leaves; umbels 3–12-rayed, the rays unequal, 1–7 cm. long, weak, ascending; involucel bracts one to few, linear, acuminate, sometimes scarious, deciduous, shorter than the pedicels; umbellets 12–15-flowered, the flowers white, the fruiting pedicels 6–17 mm. long, weak; fruit linear-oblong, 5–6 mm. long, about 3 mm. broad, the wings narrow, about half the width of the body; the oil tubes several in the intervals.

TYPE: *Geyer 325*, "on an isolated rock in the Coeur d'Aleine Mountains on wet clay," Idaho.

DISTRIBUTION: Western Idaho and adjacent Washington.

TYPICAL SPECIMENS: IDAHO: Lewiston, Nez Perce Co., *Heller & Heller 3036* (M, US). WASHINGTON: near Rock Creek, Spokane Co., *Sandberg & Leiberg 131* (M, Po, UC, US); Almata, *Piper 2794* (Po, US).

11. Lomatium Geyeri (Wats.) Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 209. 1900.

Peucedanum ambiguum acc. to Hook. Lond. Journ. Bot. **6**: 235. 1847, not Nutt. (1840).
P. Geyeri Wats. Bibl. Ind. **1**: 428. 1878; Proc. Am. Acad. **14**: 293. 1879.
P. evittatum Coult. & Rose, Bot. Gaz. **14**: 277. 1889.
Cogswellia Geyeri (Wats.) Jones, Contr. Western Bot. **12**: 33. 1908.

Plants acaulescent, 2–4.5 dm. tall, glabrous, from a shallow or deep-seated small tuber less than 1 cm. in diameter; leaves ovate-oblong, the blades 7–9 cm. long, ternate, then pinnate, the leaflets few, remote, linear, 10–50 mm. long, 1.5–3 mm. broad, apiculate, the petioles 7–13 cm. long, purplish, shortly sheathing below; peduncles exceeding the leaves; umbels 5–20-rayed, the rays unequal, 1–6 cm. long, spreading to ascending; involucel bracts more or less connate, linear-lanceolate, acuminate, scarious-margined, about equalling the white flowers; umbels several-flowered, anthers purple, the fruiting pedicels 2–5 mm. long; fruit ovate-oblong, 6–13 mm. long, 4–5 mm. broad, the wings narrower than the body, the oil tubes small, obscure, 2–6 in the intervals, about 6 on the commissure.

TYPE: *Geyer 458*, "sandy woods and plains, Upper Columbia River," April, May.

DISTRIBUTION: Eastern British Columbia to central Washington.

TYPICAL SPECIMENS: WASHINGTON: along Beverly Creek, Kittitas Co., *Thompson 9594* (Po, Th); rocky ledges near Salmon La Sac, Kittitas Co., *Thompson 10465* (Po, Th); Tumwater Mt., Wenatchee Mts., Chelan Co., *Thompson 6492* (M, Th), *10499* (Po, Th).

12. Lomatium Hendersoni Coult. & Rose, Contr. U. S. Nat. Herb. 7: 209. 1900.

Peucedanum Hendersoni Coult. & Rose, Bot. Gaz. 13: 210. 1888; Rev. N. Am. Umbell. 56. 1888.
Cogswellia Hendersoni (Coult. & Rose) Jones, Contr. Western Bot. 12: 33. 1908.

Plants acaulescent, low, mostly glabrous, from a shallow constricted tuber 1–2.5 cm. in diameter; leaves ternate, then bipinnate, the leaflets short, obtuse; umbels 2–5-rayed, the rays equal, 1–2 cm. long; involucel bracts linear, acuminate, scarious, distinct; umbellets few-flowered, the flowers white, the pedicels 3–4 mm. long; fruit ovate, 5 mm. long, 4 mm. broad, glabrous, the wings thickish, less than half as broad as the body, more or less involute, the oil tubes solitary in the intervals, 2 on the commissure.

TYPE: *Howell B* in part, on high hilltops, John Day Valley, Oregon, May 1882. Associated with the type is *Howell 410,* Lost Valley, June 1882.
DISTRIBUTION: Known only from the type collections.

This species has not been seen and the description is an adaptation from the publications of Coulter and Rose.

13. Lomatium Canbyi Coult. & Rose, Contr. U. S. Nat. Herb. 7: 210. 1900.

Peucedanum Canbyi Coult. & Rose, Bot. Gaz. 13: 78. 1888; Rev. N. Am. Umbell. 56. 1888.
Cogswellia Canbyi (Coult. & Rose) Jones, Contr. Western Bot. 12: 33. 1908.

Plants acaulescent, 1.5–2 dm. tall, glabrous, from a thick, more or less elongated rootstock ending in a globose tuber 1–2.5 cm. in diameter; leaves oblong-ovate, the blades 7–9 cm. long, ternate, then bipinnate, the leaflets distinct, linear, 4–5 mm. long, about 1 mm. broad, obtuse, mucronulate, the petioles 4–6 cm. long, forming a conspicuous scarious, purple-veined sheath; peduncles solitary, exceeding the leaves; umbels 12–17-rayed, the rays subequal, 2.7–5.5 cm. long, spreading; involucel bracts linear, acute to subacuminate, about equalling the white flowers; umbellets 13–16-flowered, the fruiting pedicels 8–12 mm. long; fruit elliptic-oblong, 7–10 mm. long, 4–6

mm. broad, the wings narrower than the body, the oil tubes 1–2 in the intervals, 2–4 on the commissure.

TYPE: *Howell 67*, high ridges, E. Oregon, April 1880, May 1882.
DISTRIBUTION: Western Idaho, eastern Washington, and Oregon.
TYPICAL SPECIMENS: WASHINGTON: Klickitat Valley, *Howell 1367* (M, UC, US). OREGON: *Cusick 1834* (M, Po, UC, US); summit of Tygh Hill, Wasco Co., *Thompson 4073* (M).

14. Lomatium Watsoni Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 211. 1900.

Peucedanum Watsoni Coult. & Rose, Bot. Gaz. **13**: 209. 1888; Rev. N. Am. Umbell. 57. 1888.
Cogswellia Watsoni (Coult. & Rose) Jones, Contr. Western Bot. **12**: 33. 1908.

Plants acaulescent, more or less puberulent, 0.8–1.5 dm. tall, from a deep-seated solitary oblong tuber, with clusters of rootlets on its surface; leaves oblong, the blades 1.5–3.5 cm. long, 2–4-pinnate, the leaflets crowded, linear, 1–5 mm. long, about 0.5 mm. broad, apiculate, the petioles 3–4.5 cm. long, sheathing partially or entirely, scarious; peduncles exceeding the leaves; umbels 1–9-rayed, the fruiting rays unequal, 0.5–2.5 cm. long, ascending; involucel bracts scarious, dimidiate, connate to near the apex, about equalling the yellow flowers; umbellets many-flowered, the fruiting pedicels obsolete to 1 mm. long; fruit ovate, 6–7 mm. long, about 3 mm. broad, puberulent, the wings less than half the width of the body, the oil tubes obscure, several in the intervals, about 6 on the commissure.

TYPE: *Howell*, Cimcoe Mts., Washington, 1881, is the first specimen cited in the original publication; in the Contr. U. S. Nat. Herb. 7: 212, the type is given by Coulter and Rose as *Howell 830*, on denuded hilltops near "Alkali," Oregon, 20 May 1882.
DISTRIBUTION: Central and western Washington, and the Blue Mts., Oregon.
SPECIMENS EXAMINED: WASHINGTON: "Cimcoe Mountains," *Howell 180* (US); high hills opposite The Dalles, Klickitat Co., *Thompson 11416* (Th); Yakima Region, *T. S. Brandegee 320* (UC). OREGON: near Alkali, *Howell 830* (Th, UC, US); Trout Creek, Blue Mts., *Howell* (US).

15. Lomatium leptocarpum (Nutt.) Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 213. 1900.

Peucedanum leptocarpum Nutt. ex Torr. & Gray, Fl. N. Am. **1**: 626. 1840, nom. nud. in synon.

P. triternatum (Pursh) Nutt. var. *leptocarpum* Torr. & Gray, Fl. N. Am. 1: 626. 1840.

P. bicolor Wats. Bot. King Exp. 129. 1871.

P. ambiguum Nutt. var. *leptocarpum* (Torr. & Gray) Coult. & Rose, Rev. N. Am. Umbell. 59. 1888.

Lomatium bicolor (Wats.) Coult. & Rose, Contr. U. S. Nat. Herb. 7: 237. 1900.

Peucedanum bicolor Wats. var. *gumbonis* Jones, Contr. Western Bot. 10: 55. 1902.

Cogswellia bicolor (Wats.) Jones, Contr. Western Bot. 12: 33. 1908.

C. leptocarpa (Nutt.) Jones, Contr. Western Bot. 12: 33. 1908.

Lomatium ambiguum (Nutt.) Coult. & Rose var. *leptocarpum* (Torr. & Gray) Jepson, Madroño 1: 159. 1924.

Plants short-caulescent, 1.5–5.5 dm. tall, glabrous to scaberulent, from elongated moniliform tuberous roots; leaves broadly obovate, the blades 9–14 cm. long, 1–2-ternate, then 2–4-pinnate, the leaflets filiform to linear, 0.5–45 mm. long, 0.1–2 mm. broad, mucronulate, the petioles 2.2–7 cm. long, entirely sheathing; peduncles exceeding the leaves; umbels 4–15-rayed, the rays unequal, 2–12 cm. long, suberect, strict; involucel bracts several, linear, acute, about equalling the yellow flowers; umbellets 10–16-flowered, the fruiting pedicels 2–7 mm. long; fruit narrowly oblong, 10–15 mm. long, 2–5 mm. broad, the wings less than half the width of the body, the oil tubes solitary in the intervals, 2–4 on the commissure.

TYPE: *Nuttall,* "Plains of the Oregon near the confluence of the Wahlamet," Oregon, July (Ph).

DISTRIBUTION: Northwestern Colorado to northeastern California, northern Idaho to the Grand Canyon, Arizona.

TYPICAL SPECIMENS: UTAH: Salt Lake City, *Jones* (M, NY, Po, US), *Watson 467* (US, NY). OREGON: stony swales, *Cusick 2381* (M, NY, Po, US); Paradise, Wallowa Co., *Cusick 2414* (M, NY, US).

The type specimen in the herbarium of the Academy of Natural Sciences, Philadelphia, labelled *Nuttall,* "Wahlamet & Columbia plains," is a mixture of material. The fruit is true *L. leptocarpum.*

16. Lomatium ambiguum (Nutt.) Coult. & Rose, Contr. U. S. Nat. Herb. 7: 212. 1900.

Eulophus ambiguus Nutt. Journ. Acad. Phila. 7: 27. 1834.

Peucedanum ambiguum Nutt. ex Torr. & Gray, Fl. N. Am. 1: 626. 1840.

P. abrotanifolium Nutt. Journ. Acad. Phila. n.s. 1: 184. 1847.
P. tenuissimum Geyer, ex Hook. Lond. Journ. Bot. 6: 235. 1847.
Cogswellia ambigua (Nutt.) Jones, Contr. Western Bot. 12: 33. 1908.

Plants caulescent, 6–44 cm. tall, glabrous, solitary or clustered at the base, alternately few-branched above, the stems purplish, especially above, from tuberous somewhat moniliform roots or elongated tap-roots; leaves oblong-ovate, the blades 2.5–12 cm. long, the lower leaves mostly ternate, then once pinnate, the upper leaves 2–3-pinnate, the leaflets mostly distinct, linear, 3–50 mm. long, 1–4 mm. broad, acute, the petioles 1–6.5 cm. long, conspicuously sheathing at the base; peduncles 2–12 cm. long, the axillary umbels mostly sterile; umbels 5–17-rayed, the rays unequal, 15–80 mm. long; involucels absent; umbellets about 20-flowered, the flowers yellow, the fruiting pedicels 4–8 mm. long; fruit narrowly oblong, 8–10 mm. long, 1.5–3 mm. broad, glabrous, the wings very narrow, the oil tubes solitary in the intervals, 2 on the commissure.

TYPE: *Wyeth*, borders on "Flat-Head River, Oregon," Montana (Ph).

DISTRIBUTION: Western Montana and Wyoming to eastern British Columbia and the eastern slopes of the Cascade Mts., Washington, the Blue and Wallowa Mts., Oregon.

TYPICAL SPECIMENS: MONTANA: Flathead-Brackett Cr. Divide, *Blankinship 221* (M, UM, US); Bridger Mts., *Rydberg & Bessey 4623* (NY, UM, US). YELLOWSTONE NATIONAL PARK: Druid Peak, *A. & E. Nelson 5782* (M, NY, US). WYOMING: Crandall Creek, *Rose 274* (M, NY, US). IDAHO: Lewiston, Nez Perce Co., *Heller & Heller 2995* (M, NY, UC, US). WASHINGTON: Pullman, *Elmer 827* (M, NY, Po, US); Peshastin, *Sandberg & Leiberg 481* (M, NY, UC, US).

17. Lomatium Cous (Wats.) Coult. & Rose, Contr. U. S. Nat. Herb. 7: 214. 1900.

Peucedanum Cous Wats. Proc. Am. Acad. 21: 453. 1886.
Cogswellia Cous (Wats.) Jones, Contr. Western Bot. 12: 33. 1908.

Plants acaulescent or short-caulescent, 2–2.5 dm. tall, from a globose, sometimes more or less elongated, tuber; leaves oblong to obovate, the blades 5.5–9.5 cm. long, mostly glabrous, ternate, then 2–3-pinnate or pinnately decompound, the leaflets crowded, ovate to oblong, 1–5 mm. long, 1–2 mm. broad, mucronulate, the petioles 3–6 cm. long, sheathing to above the middle; peduncles exceeding the leaves, scaberulent; umbels 10–20-rayed, the rays unequal, 1–5 cm. long, spreading; in-

volucel bracts oblanceolate, shortly connate below, about equalling the yellow flowers; umbellets about 20-flowered, the fruiting pedicels 2–4 mm. long; fruit oblong-elliptic, 7–10 mm. long, 3–5 mm. broad, granular-roughened, the wings narrower than the body, the oil tubes usually solitary in the intervals, 4 on the commissure.

TYPE: *Howell 270*, John Day's Valley, eastern Oregon, May 1880.

DISTRIBUTION: Western Idaho, adjacent Washington, and Oregon.

SPECIMENS EXAMINED: IDAHO: about Lewiston, Nez Perce Co., *Heller & Heller 3052* (M, UC). WASHINGTON: Wawawai, Whitman Co., *Elmer 97* (M). OREGON: Laka, Blue Mts., *Henderson 400* (M); *Howell* (M); Juniper Mt., Malheur Co., Wallowa Hill, Union Co., *Cusick 2377* (M, Po); near Fossil, Wheeler Co., *Henderson 5514* (M); *Cusick 1837* (M, Po, UC); near Prairie City, Grant Co., *Henderson 5183* (M).

The Indian name for this plant is "cous." The roots are used for food.

18. **Lomatium montanum** Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 214. 1900.

Lomatium purpureum A. Nels. Bull. Torrey Bot. Club **28**: 226. 1901.

Peucedanum montanum (Coult. & Rose) Blankinship, Mont. Agric. Coll. Studies, Bot. **1**: 93. 1905.

Cogswellia montana (Coult. & Rose) Jones, Contr. Western Bot. **12**: 34, 36. 1908.

Plants acaulescent, 1–3 dm. tall, glabrous, caespitose from a thickened tap-root or a subglobose tuber; leaves mostly oblong, the blades 2.5–12 cm. long, ternate, then 2–3-pinnate, the leaflets crowded, oblong, 2–10 mm. long, 0.5–3 mm. broad, apiculate, the petioles 1.5–7 cm. long, sheathing to above the middle, purplish; peduncles exceeding the leaves; umbels 5–15-rayed, the fruiting rays unequal, 1–6.5 cm. long; involucel bracts conspicuous, obovate, distinct or united below, purplish; umbellets about 20-flowered, the fruiting pedicels 2–3 mm. long; fruit elliptic-oblong, 5–12 mm. long, 3–5 mm. broad, the wings narrower than to about equalling the body, the oil tubes 2–4 in the intervals, 6 on the commissure.

TYPE: *Rose 479*, mountain ridges in Yellowstone National Park, 19 August 1893 (US).

DISTRIBUTION: Mountains, western Montana and Wyoming, west to eastern Oregon.

TYPICAL SPECIMENS: MONTANA: Mt. Bridger, Mystic Lake, *Blankinship 223* (M, UM, US). YELLOWSTONE NATIONAL PARK: Madison River, *Nelson & Nelson 5496* (M, Po, US).

19. Lomatium circumdatum (Wats.) Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 213. 1900.

Peucedanum circumdatum Wats. Proc. Am. Acad. **22**: 474. 1887.
Cogswellia circumdata (Wats.) Jones, Contr. Western Bot. **12**: 33. 1908.

Plants caulescent, 1.5–3.5 dm. tall, glabrous to somewhat pubescent, from an elongated to subglobose tuber; leaves broadly oblong, the blades 5–6 cm. long, ternate, then 1–2-pinnate, the leaflets distinct, linear, 6–10 mm. long, 1–2 mm. broad, apiculate, the petioles 3–6 cm. long, entirely scarious sheathing in the stem leaves; peduncles exceeding the leaves; umbels 7–12-rayed, the fruiting rays ascending, 2–8 cm. long; involucel bracts conspicuous, obovate, acute, prominently nerved, sometimes connate, much longer than the yellow flowers; umbellets many-flowered, the fruiting pedicels 2–3 mm. long; fruit oblong, 6–9 mm. long, 3–4 mm. broad, glabrous, the wings much narrower than the body, the oil tubes solitary in the intervals, 4 on the commissure.

TYPE: *Cusick*, "abundant on hillsides in the Wallowa region of eastern Oregon," June 1886.

DISTRIBUTION: Western Idaho and adjacent Washington and Oregon.

SPECIMENS EXAMINED: IDAHO: on the lower Clearwater River, Nez Perce Co., *Sandberg, MacDougal & Heller 21* (Po, US); near Lewiston, Nez Perce Co., *Heller & Heller 4043* (Po); Julietta, Hatwai Co., Lake Waha, *Henderson 4847* (US). WASHINGTON: Blue Mts., Walla Walla Co., *Piper 2341* (Po). OREGON: Billy Meadows, Wallowa National Forest, *Jardine 198* (US); near Harper Ranch, Malheur Co., *Leiberg 2123* (US); dry hills of the Wallowa, *Cusick 1394* (US type coll., UC); Buckhorn Springs, Wallowa Co., *Peck 18285* (Th); dry slope 15 mi. n. e. of Enterprise, Wallowa Co., *Peck 17467* (Th).

20. Lomatium vaginatum Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 223. 1900.

Cogswellia vaginata (Coult. & Rose) Jones, Contr. Western Bot. **12**: 34. 1908.

Plants caulescent, 2.3–4.5 dm. tall, more or less scabrous, from an elongated, more or less thickened root; leaves ovate, the blades 5–13 cm. long, ternate, then 1–2-pinnate, the leaflets crowded, oblong, 1–5 mm. long, about 1 mm. broad, apiculate,

the petioles 1.5–9 cm. long, entirely sheathing in the stem leaves; peduncles exceeding the leaves; umbels 14–25-rayed, the fruiting rays 6–12, unequal, 1–4.5 cm. long, ascending; involucel bracts conspicuous, oblanceolate to obovate, acute; umbellets many-flowered, the flowers yellow, the fruiting pedicels 3–8 mm. long; fruit broadly elliptical to somewhat obovate, 8–12 mm. long, 5–8 mm. broad, granulate-roughened, the wings nearly as broad as the body, the oil tubes 3–4 in the intervals, 4 on the commissure.

TYPE: *Cusick 1655* (*"1697"*), Logan Valley, Union Co., Oregon (US TYPE, M, Po, UC).

DISTRIBUTION: Eastern Oregon and northeastern California.

SPECIMENS EXAMINED: OREGON: near Beulah, Malheur Co., *Leiberg 2293* (Po, UC); Owyhee, Malheur Divide, *Leiberg 2160* (UC); 10 mi. north of Mitchell, Wheeler Co., *Peck 16020* (Th); Lakeview, *Peck 15254* (Th); Barren Valley, *Cusick 2563* (M, Po in part).

21. Lomatium utriculatum (Nutt.) Coult. & Rose, Contr. U. S. Nat. Herb. 7: 215. 1900.

Peucedanum utriculatum Nutt. ex Torr. & Gray, Fl. N. Am. 1: 628. 1840.

Cogswellia caruifolia (Hook. & Arn.) Jones var. *patens* Jones, Contr. Western Bot. 12: 41. 1908.

C. utriculata (Nutt.) Jones, Contr. Western Bot. 12: 34. 1908.

C. Chandleri Jones, Contr. Western Bot. 13: 11. 1910.

Lomatium Chandleri (Jones) Macbr. Contr. Gray Herb. n.s. 53: 15. 1918.

L. utriculatum (Nutt.) Coult. & Rose var. *glabrum* Jepson, Madroño 1: 152. 1924.

L. utriculatum (Nutt.) Coult. & Rose var. *anthemifolium* Jepson, Fl. Calif. 2^1: 639. 1936.

Plants caulescent, 1–5 dm. tall, glabrous to pubescent, purplish below, from a long slender tap-root; leaves oblong, the blades 2.5–16 cm. long, tripinnate, sometimes ternate, then tripinnate, the leaflets linear, 2–25 mm. long, 0.5–3 mm. broad, apiculate, the petioles 1–10 cm. long, wholly sheathing except in some of the basal leaves; terminal peduncles exceeding the leaves; umbels 5–13-rayed, the fruiting rays unequal, 1–12 cm. long, spreading to ascending; involucel bracts obovate, entire to cleft, green with a scarious margin to purplish and subscarious, occasionally prominently nerved, about equalling the yellow flowers; umbellets about 20-flowered, the fruiting pedicels 2–9 mm. long; fruit ovate to oblong, 5–11 mm. long, 3–8

mm. broad, puberulent when young, becoming glabrous, the wings thin, mostly broader than the body, the oil tubes 1–3 in the dorsal intervals, 1–4 in the lateral intervals, 2–6 on the commissure, rarely obscure.

TYPE: *Nuttall*, "rocky plains, particularly near the confluence of the Wahlamet and Oregon Rivers," Oregon (Ph).

DISTRIBUTION: British Columbia to southern California.

TYPICAL SPECIMENS: WASHINGTON: Lopez, San Juan Islands, *Zeller & Zeller 1259* (M, NY); Goose Rock, Whidby Island, Island Co., *Thompson 6041, 8934* (M, NY, UC). CALIFORNIA: near Lakeport, Lake Co., *Baker 3063* (M, NY, UC); Nelson Range, Inyo Co., *Hall & Chandler 7157* (UC); grade between Clear Creek and Paradise, Butte Co., *Heller & Brown 5542* (M, NY); *Bridges 131* (NY).

21a. Lomatium utriculatum (Nutt.) Coult. & Rose var. **papillatum** (Henderson) Mathias, comb. nov.

Cogswellia utriculata (Nutt.) Jones var. *papillata* Henderson, Rhodora **33**: 204. 1931.

Similar to the species but the mature fruit roughened with budlike 1–several-celled papillae.

TYPE: *Henderson 12614*, south slope of Siskiyou Mts., in copses near the California line, Jackson Co., Oregon, 17 May, 12 June 1930 (UO).

DISTRIBUTION: Oregon.

22. Lomatium Vaseyi Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 216. 1900.

Peucedanum Vaseyi Coult. & Rose, Bot. Gaz. **13**: 144. 1888; Rev. N. Am. Umbell. 67. 1888.

Cogswellia Vaseyi Coult. & Rose, Contr. U. S. Nat. Herb. **12**: 451. 1909.

C. caruifolia (Hook. & Arn.) Jones var. *Vaseyi* (Coult. & Rose) Jones, Contr. Western Bot. **12**: 41. 1908.

Plants caulescent, 2.5–3.5 dm. tall, sparsely to densely pubescent with pilose hairs, from a long somewhat thickened taproot; leaves broadly oblong, the blades 4–8 cm. long, ternate, then bipinnate, the leaflets oblong, 3–17 mm. long, 0.5–1 mm. broad, apiculate, the petioles 1.5–7 cm. long, partially to wholly sheathing in the stem leaves; peduncles exceeding the leaves; umbels 10–20-rayed, the fruiting rays unequal, 2–7.5 cm. long, ascending; involucel bracts obovate, scarious-margined, entire or lobed toward the apex, glabrous or villosulose, about equaling the yellow flowers; umbellets about 30-flowered, the fruiting

pedicels 3–8 mm. long; fruit ovate to obovate, 9–15 mm. long, 5–10 mm. broad, glabrous, the wings thin, usually broader than the body, the dorsal ribs filiform, the oil tubes solitary in the intervals, 4 on the commissure, the calyx lobes prominent, especially in the young fruit.

TYPE: *Vasey 231*, San Bernardino Mts., California, May 1880.

DISTRIBUTION: Southern California, southern Inyo Co. to San Luis Obispo Co., south to San Diego Co.

TYPICAL SPECIMENS: CALIFORNIA: San Jacinto, *Jones 3172* (M, NY, UC); Highland, San Bernardino Co., *Parish* (NY, UC); San Bernardino, *Parish 4699* (NY, UC).

23. Lomatium caruifolium (Hook. & Arn.) Coult. & Rose, Contr. U. S. Nat. Herb. 7: 216. 1900.

Ferula caruifolia Hook. & Arn. Bot. Beechey Voy. 348. 1840.

Peucedanum caruifolium (Hook. & Arn.) Torr. & Gray, Fl. N. Am. 1: 628. 1840.

P. californicum Nutt. ex Torr. & Gray, Fl. N. Am. 1: 628. 1840, *nom. nud.* in synon., not of Coult. & Rose (1888).

Cogswellia caruifolia (Hook. & Arn.) Jones, Contr. Western Bot. 12: 34. 1908.

Lomatium caruifolium (Hook. & Arn.) Coult. & Rose var. *solanense* Jepson, Madroño 1: 151. 1924.

L. caruifolium (Hook. & Arn.) Coult. & Rose var. *erythropodum* Jepson, Fl. Calif. 2^1: 638. 1936.

Plants acaulescent or short-caulescent, 2–3 dm. tall, glabrous to slightly pubescent, from a long slender tap-root; leaves broadly ovate to obovate, the blades 9–11 cm. long, 1–3-ternate, or simply ternate, then bipinnate, the leaflets linear, 2–15 mm. long, about 1 mm. broad, apiculate, the petioles 4–7 cm. long, wholly inflated; peduncles exceeding the leaves; umbels 4–11-rayed, the rays unequal, 1.3–12 cm. long; involucel bracts obovate, sessile or petiolulate, entire or toothed, green to purplish, scarious-margined, prominently veined, equalling the yellow flowers; umbellets many-flowered, the fruiting pedicels 1–10 mm. long; fruit narrowly ovate to obovate, 7–8 mm. long, about 5 mm. broad, glabrous, the wings thickish, narrower than the body, the oil tubes obscure.

TYPE: *Douglas*, California.

DISTRIBUTION: Coast ranges, San Luis Obispo Co. to Humboldt and Trinity counties, California.

TYPICAL SPECIMENS: CALIFORNIA: San Luis Obispo, *Jones 3600* (M, Po, NY); Crystal Springs Lake, San Mateo Co., *Baker 426* (M, NY, Po, UC); Castroville, Monterey Co., *Elmer 4763* (M, NY, UC).

23a. Lomatium caruifolium (Hook. & Arn.) Coult. & Rose var. **denticulatum** Jepson, Madroño **1**: 151. 1924.

Peucedanum erosum Jepson, Erythea **5**: 1. 1897.

Rays unequal, 6.5–14 cm. long; wing margins roughened or denticulate.

TYPE: *Eastwood*, Exeter, Tulare Co., on the east side of the San Joaquin Valley, California, 26 May 1895.

DISTRIBUTION: Known only from the type collection.

23b. Lomatium caruifolium (Hook. & Arn.) Coult. & Rose var. **marginatum** (Benth.) Mathias, comb. nov.

Peucedanum marginatum Benth. Pl. Hartw. 312. 1849.
Lomatium marginatum (Benth.) Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 223. 1900.
Cogswellia marginata (Benth.) Jones, Contr. Western Bot. **12**: 35. 1908.
Lomatium alatum acc. to Jepson, Man. 724. 1925, not Coult. & Rose (1900).

Plants rarely short-caulescent, mostly taller than the species; leaf-blades up to 20 cm. long, the leaflets remote, filiform to linear, 0.5–4.5 cm. long, the petioles 13 cm. long; involucel bracts linear, rarely absent, distinct, subacuminate, white-scarious-margined, rarely toothed at the apex, exceeding the yellow flowers; fruiting pedicels up to 13 mm. long; fruit up to 10 mm. long.

TYPE: *Hartweg 1752 (260)*, "in valle Sacramento," California (G type coll.).

DISTRIBUTION: Western slopes of the northern Sierra Nevada foothills, California.

SPECIMENS EXAMINED: CALIFORNIA: 8 miles north of Oroville, Butte Co., *Heller 11769* (Cl); Salmon Falls, Eldorado Co., *K. Brandegee* (UC); near Jenny Lind, Calaveras Co., *Stanford 1207* (M); New York Ravine, Eldorado Co., *K. Brandegee* (UC); near Collegeville, San Joaquin Co., *Stanford 847* (Po).

The specimens cited above apparently belong to this variety although they differ from the type in having the leaflets usually filiform instead of linear, the involucels sometimes wanting, and the pedicels mostly shorter.

This variety seems to be a robust form of the species but can be distinguished by its involucel bracts.

23c. Lomatium caruifolium (Hook. & Arn.) Coult. & Rose var. **purpureum** (Jepson) Mathias, comb. nov.

Lomatium alatum Coult. & Rose var. *purpureum* Jepson, Madroño **1**: 158. 1924.
L. marginatum (Benth.) Coult. & Rose var. *purpureum* Jepson, Fl. Calif. **2**[1]: 645. 1936.

Leaflets filiform, usually longer than in the species; involucel bracts filiform to lanceolate, rarely oblanceolate; flowers purple.

TYPE: *Jepson*, Conn Valley, Napa Range, California.
DISTRIBUTION: Known only from Napa Co., California.
SPECIMENS EXAMINED: CALIFORNIA: Butts Valley Road to Middletown, 5 miles from Aetna Springs, *Howell 6148* (UC); 5 mi. n. e. of Aetna Springs along Butts Creek, *Keck 1076* (M, Po); Knoxville, *Baker 2971* (M, Po); 1.9 mi. southeast of Napa-Lake Co. line, on Knoxville Road, *Mathias 1298* (UC).

24. Lomatium nevadense (Wats.) Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 220. 1900.

Peucedanum nevadense Wats. Proc. Am. Acad. **11**: 143. 1876.
P. nudicaule acc. to Wats. Bot. King Exp. 130. 1871, and others, not Nutt. (1840), in part (excl. *Hall & Harbour 212* and Parry's Colorado collection).
P. nevadense Wats. var. *cupulatum* Jones, Contr. Western Bot. **8**: 29. 1898.
Lomatium nevadense (Wats.) Coult. & Rose var. *cupulatum* (Jones) Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 221. 1900.
Cogswellia nevadensis (Wats.) Jones, Contr. Western Bot. **12**: 33. 1908.
C. nevadensis (Wats.) Jones var. *cupulata* Jones, Contr. Western Bot. **12**: 33. 1908.

Plants acaulescent or short-caulescent, 1–4.5 dm. tall, pubescent, from a long slender tap-root; leaves oblong to obovate, the blades 5–6 cm. long, tripinnate, the leaflets crowded, oblong, 2–3 mm. long, about 1 mm. broad, apiculate, the petioles 4–6 cm. long, sheathing to above the middle, purplish; peduncles exceeding the leaves; umbels 8–22-rayed, the fruiting rays unequal, 1–2.5 cm. long, spreading; involucel bracts conspicuous, about equalling the white flowers, linear and distinct or obovate and connate, scarious-margined; umbellets about 20-flowered, the fruiting pedicels 3–10 mm. long; fruit more or less puberulent, ovate to oblong-obovate, 6–8 mm. long, 4–6 mm. broad, the wings narrower than the body, the oil tubes 2–9 in the intervals, 4–12 on the commissure.

TYPE: *Watson 469*, "very frequent in western Nevada from the Washoe to the West Humboldt Mountains," 4500–6000 feet (US TYPE, NY).

DISTRIBUTION: Western Utah to Oregon and eastern California, south to southern Arizona.

TYPICAL SPECIMENS: NEVADA: north of Reno, Washoe Co., *Heller 10243* (M, NY, US); Empire City, *Jones 3880* (M, NY, Po, US). CALIFORNIA: Prosser Creek near Truckee, Nevada Co., *Sonne 358* (M).

24a. Lomatium nevadense (Wats.) Coult. & Rose var. Parishii (Coult. & Rose) Jepson, Madroño 1: 156. 1924.

Peucedanum Parishii Coult. & Rose, Bot. Gaz. **13**: 209. 1888.
Lomatium Parishii Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 235. 1900.
Cogswellia nevadensis (Wats.) Jones var. *Parishii* (Coult. & Rose) Jones, Contr. Western Bot. **12**: 33. 1908.
C. decipiens Jones, Contr. Western Bot. **12**: 34, 38. 1908.
C. Parishii Coult. & Rose, Contr. U. S. Nat. Herb. **12**: 450. 1909.

Mostly taller than the species, leaf segments sometimes elongate, up to 35 mm. long; rays usually longer, 1.5–5.5 cm. long; involucel bracts sometimes reduced to a sheath or a single bract; pedicels 3–12 mm. long; ovaries glabrous; fruit 7–10 mm. long, 3–6 mm. broad, glabrous, the oil tubes 1–4 in the intervals, 4–7 on the commissure.

TYPE: *Parish 1828*, Bear Valley (San Bernardino Mts.), California (NY, UC, US type coll.).

DISTRIBUTION: Western New Mexico to the San Bernardino Mts., California, southeastern Oregon to northern Sonora.

TYPICAL SPECIMENS: NEW MEXICO: Mangus Springs, *Rusby 148* (M, US). NEVADA: Mica Mine, *Jones 5072f* (Po, US). CALIFORNIA: n. side Old Baldy Mt., San Bernardino Co., *Parish 1942* (US); Pah Ute Peak, *Purpus 5288* (M, UC, US).

24b. Lomatium nevadense (Wats.) Coult. & Rose var. pseudorientale (Jones) Munz, Man. So. Calif. Bot. 360. 1935.

Cogswellia nevadensis (Wats.) Jones var. *pseudorientalis* Jones, Contr. Western Bot. **12**: 33, 37. 1908.
Lomatium nevadense (Wats.) Coult. & Rose var. *holopterum* Jepson, Madroño **1**: 156. 1924.

Similar to variety *Parishii*, the petioles more prominently scarious-margined; wings broader than the body, the dorsal ribs evident.

TYPE: *Jones*, Skull Valley, northwestern Arizona, 4300 feet, 1 May 1903 (Po).

DISTRIBUTION: Northwestern Arizona and adjacent Nevada and California.

SPECIMENS EXAMINED: NEVADA: Good Springs, *K. Brandegee* (UC). ARIZONA: Skull Valley, *Jones* (NY, Po, US); Prescott, *Harrison 4013* (US); Williams to Ash Fork, *Loomis 6929* (NY); Chloride, *Jones* (Po, NY); Hualapai Mts., *Jones* (Po); Grand Cañon, *Jones* (Po). CALIFORNIA: vic. of Bonanza King Mine, east slope of Providence Mts., Mojave Desert, *Munz, Johnston & Harwood 4236* (Po, US); Barnwell, *K. Brandegee* (Po, UC); Mojave, *Jones* (UC), *Purpus 7092a* (UC).

25. Lomatium Plummerae Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 232. 1900.

Peucedanum Plummerae Coult. & Rose, Bot. Gaz. **14**: 278. 1889.
Cogswellia Plummerae (Coult. & Rose) Jones, Contr. Western Bot. **12**: 34, 35. 1908.

Plants short-caulescent, 2–3.5 dm. tall, glabrous, from a long slender tap-root; leaves crowded near the base, oblong, the blades 5–10 cm. long, ternate, then bipinnate, the leaflets linear to oblong, 3–7 mm. long, 0.5–1 mm. broad, apiculate, the petioles 3–6 cm. long, entirely sheathing, scarious-margined; peduncles exceeding the leaves; umbels 10–25-rayed, the fruiting rays unequal, 0.5–7.5 cm. long, ascending; involucel bracts dimidiate, linear-lanceolate, acute, distinct or connate to above the middle, scarious at least on the margin, prominently nerved, entire or toothed, equalling to exceeding the yellow or purplish (white ?) flowers; umbellets many-flowered, the fruiting pedicels 3–8 mm. long; fruit oblong to oblong-ovate, 9–13 mm. long, 4–7 mm. broad, glabrous, usually acute at the apex, the wings narrower than the body, the oil tubes 1, rarely 2–3, in the intervals, 4–8 on the commissure.

TYPE: *Lemmon & Lemmon, 32* and *40,* Sierra Valley, Sierra Co., May 1889, and near Shasta, Shasta Co., 28 June 1889 (UC type coll.).

DISTRIBUTION: Northern Sierra Nevada from Sierra Co. to Shasta Co., California.

SPECIMENS EXAMINED: NEVADA: along road to Reno, *Sonne* (UC). CALIFORNIA: west of Verdi, Nevada, *Mathias 1207* (UC); Sierra Valley, *Lemmon s. n.* (UC); near Shasta, *Lemmon* (UC).

Lomatium Plummerae was originally described as having white flowers. It is very possible that this was an error easily made in a study from dried specimens. *Mathias 1207* is an excellent match for the type material of *L. Plummerae* but has yellow or purplish flowers.

25a. Lomatium Plummerae Coult. & Rose var. **Sonnei** (Coult. & Rose) Jepson, Madroño **1**: 157. 1924.

Lomatium Sonnei Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 236. 1900.
Cogswellia Sonnei (Coult. & Rose) Jones, Contr. Western Bot. **12**: 34. 1908.

Similar to the species but pubescent; the fruiting pedicels up to 10 mm. long; fruit glabrous.

TYPE: *Sonne*, sandy soil among sagebrush, Verdi, Washoe Co., Nevada, 5 May, 16 June 1895 (US).

DISTRIBUTION: Western Sierra Co., California, and adjacent Nevada.

SPECIMENS EXAMINED: NEVADA: along road to Reno, *Sonne* (UC); Verdi, Washoe Co., *Sonne* (UC type coll.); Reno, *Cowgill* (UC), *Jones* (Po), *Hillman* (Po), *Canby 24* (Po); Truckee Pass, Washoe Co., *Kennedy 1338* (M, UC); 2 mi. south of Virginia City, *Mathias 1269* (UC); 8 mi. n. e. of Reno, along Pyramid Lake Road, *Mathias 1223* (UC); 2 mi. east of Verdi, *Mathias 1215* (UC); about 10 mi. east of Glenbrook along Carson City Road, *Mathias 1271, 1272* (UC). CALIFORNIA: west of Verdi, Nevada, *Mathias 1208* (UC).

Jepson's interpretation of *L. Sonnei* as a variety of *L. Plummerae* is undoubtedly correct, since *Mathias 1207, L. Plummerae,* and *Mathias 1208,* variety *Sonnei,* were collected together near the type locality of the latter.

25b. Lomatium Plummerae Coult. & Rose var. **Austinae** (Coult. & Rose) Mathias, comb. nov.

Peucedanum Austinae Coult. & Rose, Bot. Gaz. 13: 208. 1888; Rev. N. Am. Umbell. 66. 1888.
Lomatium Austinae Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 236. 1900.
Cogswellia Austinae (Coult. & Rose) Jones, Contr. Western Bot. **12**: 35. 1908.

Similar to variety *Sonnei* in pubescence; fruit ovate, about 8 mm. long, about 5 mm. broad, not pointed at the apex.

TYPE: *Mrs. R. M. Austin*, Plumas Co., California, June 1880.

DISTRIBUTION: Known only from Plumas Co., California.

SPECIMENS EXAMINED: CALIFORNIA: Mohawk Valley, Plumas Co., *Lemmon 23, s. n.* (UC).

This plant has been distinguished by its purplish flowers. Specimens of *L. Plummerae* and its variety, *Sonnei,* frequently have purplish flowers, a character which is not apparent in herbarium material.

25c. Lomatium Plummerae Coult. & Rose var. **Helleri** Mathias, var. nov.

Planta 3.0–3.8 dm. alta cum 1–2-foliis caulinis, fructibus immaturis granulatis.

Plants 3–3.8 dm. tall, more caulescent than the species, with 1–2 stem leaves above, the primary leaf divisions more remote; sometimes scaberulent at the nodes; pedicels up to 10 mm. long; young fruit granulate-roughened.

TYPE: *Heller 10838*, near Marston Station, Plumas Co., California, 3500 feet, 13 June 1913 (UC 175513 TYPE, M).

DISTRIBUTION: Known only from the type collection.

26. Lomatium MacDougali Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 233. 1900.

Lomatium Jonesii Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 233. 1900.
Cogswellia MacDougali (Coult. & Rose) Jones, Contr. Western Bot. **12**: 34. 1908.
C. Jonesii (Coult. & Rose) Jones, Contr. Western Bot. **12**: 34. 1908.
Lomatium semisepultum Peck, Proc. Biol. Soc. Wash. **50**: 122. 1937.

Plants acaulescent, 0.7–3 dm. tall, more or less villous throughout, from a long slender tap-root; leaves oblong-ovate, the blades 2–15 cm. long, ternate, then tripinnate, the leaflets crowded, linear to ovate, 1–5 mm. long, 0.5–1 mm. broad, apiculate, the petioles 1–2.5 cm. long, shorter than the leaf blades, mostly sheathing throughout, purplish; peduncles exceeding the leaves; umbels 2–14-rayed, the rays 0.5–6 cm. long, spreading; involucel bracts scarious, linear, usually distinct, villous; umbellets about 20-flowered, the flowers yellow, somewhat purplish-tinged, the fruiting pedicels 3–10 mm. long; fruit ovate to suborbicular, 6–11 mm. long, 4–7 mm. broad, pubescent, the wings narrower than the body, the oil tubes 1–4 in the intervals, 4–6 on the commissure.

TYPE: *Jones 5435*, Irelands Ranch, head of Salina Canyon, Utah, alt. 2400 m., 15 June 1894 (US).

DISTRIBUTION: Great Basin, from western Wyoming to central Oregon, south to central Arizona.

TYPICAL SPECIMENS: WYOMING: Ft. Steele, *Nelson 4835* (NY, US); Cooper Lake, Albany Co., *Goodding 13* (M, NY, Po, US). UTAH: Frisco, *Jones 1689* (NY, US). ARIZONA: Mormon Lake, *MacDougal 84* (NY, UC, US type of *L. MacDougali*); Walnut Canyon, *Purpus 20* (M, UC, US).

27. Lomatium juniperinum (Jones) Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 235. 1900.

Peucedanum juniperinum Jones, Contr. Western Bot. **8**: 29. 1898.
Cogswellia juniperina Jones, Contr. Western Bot. **12**: 34. 1908.

Plants acaulescent or short-caulescent, 1.2–2.2 dm. tall, puberulent, from a long slender tap-root; stems purplish below; leaves broadly ovate, the blades 3–6 cm. long, 1–2-ternate or quinate, then 2–3-pinnate, the leaflets crowded, filiform to linear, 1–4 mm. long, 0.5–1 mm. broad, entire, apiculate, the petioles 1.5–3 cm. long, entirely sheathing; peduncles exceeding the leaves; umbels 8–20-rayed, the fruiting rays 3–8, unequal, 1–5 cm. long, ascending; involucel bracts filiform-subulate, scarious, about equalling the yellow flowers; umbellets many-flowered, the fruiting pedicels 5–10 mm. long; ovaries and fruit glabrous, the fruit oblong, 5–8 mm. long, 3–4 mm. broad, the wings about half the width of the body, the oil tubes 2–3 in the intervals, 4 on the commissure.

TYPE: *Jones*, among junipers, Coalville, Utah, 14 May 1889 (Po).
DISTRIBUTION: Northern Utah, adjacent Idaho, and Wyoming.
TYPICAL SPECIMENS: WYOMING: Evanston, *Nelson 3016* (M); Carter, *Jones* (Po).

28. Lomatium foeniculaceum (Nutt.) Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 222. 1900.

? *Ferula pubescens* Nutt. in Fraser's Cat. 1813, nom. nud.
F. foeniculacea Nutt. Gen. Am. **1**: 183. 1818.
Lomatium villosum Raf. Journ. Phys. **89**: 101. 1819.
Cogswellia villosa (Raf.) Spreng. ex Linn. Syst. Veg. ed. Roem. & Schult. **6**: XLVIII. 1820.
Pastinaca foeniculacea (Nutt.) Spreng. ex Linn. Syst. Veg. ed. Roem. & Schult. **6**: 587. 1820.
Lomatium pubescens Raf. ex Seringe, Bull. Bot. **1**: 216. 1830.
L. athamantoides Raf. The Good Book **1**: 55. 1840.
Peucedanum foeniculaceum Nutt. ex Torr. & Gray, Fl. N. Am. **1**: 627. 1840.
P. foeniculaceum Nutt. var. *daucifolium* Nutt. ex Torr. & Gray, Fl. N. Am. **1**: 627. 1840, as to specimens from Saskatchewan.
Pastinaca ferulacea Walp. Rep. **2**: 412. 1844–45, nom. nud. in synon.
Peucedanum villosum (Raf.) Nutt. ex Wats. Bot. King Exp. 131. 1871.
Cogswellia villosa (Raf.) Jones, Contr. Western Bot. **12**: 34. 1908.
C. foeniculacea (Nutt.) Coult. & Rose, Contr. U. S. Nat. Herb. **12**: 449. 1909.

Plants acaulescent, 1–5 dm. tall, villous to glabrate, from a long, more or less thickened tap-root; leaves ovate to oblong, the blades 4.5–13 cm. long, 3–4-pinnate, the leaflets crowded, linear, 2–4 mm. long, about 0.5–1 mm. broad apiculate, the petioles 3–8 cm. long, sheathing about to the middle, the sheath purplish, subscarious; peduncles exceeding the leaves; umbels 8–24-rayed, the rays subequal, 0.7–12.5 cm. long, spreading to erect; involucel bracts dimidiate, lanceolate, connate below, entire or lobed, acute to acuminate, somewhat scarious-margined, about equalling the yellow flowers; umbellets 25–50-flowered, the fruiting pedicels 2–13 mm. long; fruit ovate-oblong, 7–10 mm. long, 4–6 mm. broad, more or less pubescent, the wings narrower than the body, the oil tubes 3 in the intervals, 4 on the commissure.

TYPE: *Nuttall*, "on the high plains of the Missouri, commencing about the confluence of the river Jauke." (Probably the James (Jacques) River in South Dakota.)

DISTRIBUTION: Manitoba to northern Oklahoma, western Missouri to western Montana and Wyoming.

TYPICAL SPECIMENS: SOUTH DAKOTA: Newell, *Carr 1* (M, NY, US); Fort Meade, *Forwood 145* (M, US). WYOMING: 45 miles n. of Point of Rocks, *Merrill & Wilcox B 571* (NY, US); Ft. Steele, *Nelson 4835* (M).

29. **Lomatium daucifolium** (Nutt.) Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 221. 1900.

Peucedanum foeniculaceum Nutt. var. *daucifolium* Nutt. ex Torr. & Gray, Fl. N. Am. 1: 627. 1840, in part.

P. daucifolium Nutt. ex Torr. & Gray, Fl. N. Am. 1: 627. 1840, nom. nud. in synon.

P. villosum Nutt. ex Wats. Bot. King Exped. 131. 1871, in part.

Cogswellia daucifolia (Nutt.) Jones, Contr. Western Bot. **12**: 34. 1908.

Peucedanum foeniculaceum of many later authors, not Nutt. (1840).

Plants acaulescent, 1–4.5 dm. tall, villous-tomentose to glabrate, from a long, more or less swollen tap-root; leaves broadly ovate to obovate, the blades 5–19 cm. long, ternate, then 3–4-pinnate, the leaflets linear, 2–8 mm. long, about 0.5 mm. broad, more or less crowded, entire, apiculate, the petioles 3–13 cm. long, purplish, sheathing below; peduncles exceeding the leaves; umbels 12–30-rayed, the rays subequal, 1.5–7 cm. long, erect to speading; involucel bracts subdimidiate,

lanceolate, acute to acuminate, subscarious, conspicuously nerved, connate to above the middle, equalling the yellow flowers; umbellets 20–40-flowered, the fruiting pedicels 4–13 mm. long, the ovaries glabrous; fruit ovate-oblong, 6–9 mm. long, 3–6 mm. broad, glabrous, the wings narrower than the body, the oil tubes 1–3 in the intervals, 2–4 on the commissure, occasionally solitary near the base of each wing.

TYPE: *Nuttall*, on the Platte, probably in Nebraska (NY, Ph).

DISTRIBUTION: Southern South Dakota to Texas.

TYPICAL SPECIMENS: MISSOURI: Independence, Jackson Co., *Bush 322* (M, NY, US). KANSAS: Riley Co., *Norton 190, 190a* (M, NY, US). OKLAHOMA: near Cora, Woods Co., *Stevens 221* (M, US); Norman, *Gould* (M).

30. **Lomatium orientale** Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 220. 1900.

Peucedanum nudicaule Nutt. ex Torr. & Gray, Fl. N. Am. 1: 627. 1840, in large part, and of all later authors.

P. orientale (Coult. & Rose) Blankinship, Mont. Agric. Coll. Sci. Studies, Bot. 1: 93. 1905.

Cogswellia orientalis (Coult. & Rose) Jones, Contr. Western Bot. **12**: 33. 1908.

Plants short-caulescent, 1–4 dm. tall, soft-puberulent, from a long slender tap-root; leaves ovate to oblong, the blades 4–11 cm. long, tripinnate, the leaflets crowded, the uppermost confluent, linear, 1–12 mm. long, 0.5–2 mm. broad, apiculate, the petioles 2–12 cm. long, sheathing below, petioles of cauline leaves entirely sheathing; fruiting peduncles exceeding the leaves; umbels 6–21-rayed, the rays 1.2–5.5 cm. long, subequal; involucel bracts linear-lanceolate to more or less obovate, distinct, scarious-margined, about equalling the white flowers; umbellets about 20-flowered, the fruiting pedicels 3–9 mm. long, glabrous; fruit ovate-oblong, 5–10 mm. long, 3–7 mm. broad, glabrous, the wings narrower than the body, the oil tubes 1–4 in the intervals, 2–8 on the commissure, rarely 1–2 near the base of the wings.

TYPE: *Bethel*, plains around Denver, Colorado, May 1895 (US).

DISTRIBUTION: Western Minnesota to Kansas, west to Montana and Colorado.

TYPICAL SPECIMENS: NORTH DAKOTA: Leeds, *Lunell* (M, NY). WYOMING: sandy valleys and slopes, Sand Creek, Albany Co., *Nelson 7013* (M, NY, Po). COLORADO: Loveland, *Nelson 10754* (M, NY); Larimer Co., *Baker 203* (M).

31. Lomatium dasycarpum (Torr. & Gray) Coult. & Rose, Contr. U. S. Nat. Herb. 7: 218. 1900.

Peucedanum dasycarpum Torr. & Gray, Fl. N. Am. 1: 628. 1840.
P. foeniculaceum Torr. Bot. Mex. Bound. Surv. 70. 1859, not Nutt. (1840).
P. Pringlei Coult. & Rose, Bot. Gaz. 13: 209. 1888.
P. Jaredi Eastw. Zoe 5: 88. 1900.
Cogswellia Jaredi (Eastw.) Coult. & Rose, Contr. U. S. Nat. Herb. 12: 450. 1909.
C. dasycarpa (Torr. & Gray) Jones, Contr. Western Bot. 12: 34. 1908.
Lomatium dasycarpum (Torr. & Gray) Coult. & Rose var. *decorum* Jepson, Madroño 1: 154. 1924.
L. dasycarpum (Torr. & Gray) Coult. & Rose var. *medium* Jepson, Madroño 1: 154. 1924.

Plants acaulescent or short-caulescent, 1–4 dm. tall, villous-tomentose to glabrate, purplish, especially below, from a long slender tap-root; leaves oblong to ovate, the blades 3–13.5 cm. long, quadripinnate, occasionally ternate, then pinnately decompound, the leaflets crowded, not confluent, linear, 1–3 mm. long, about 0.5 mm. broad, entire, obtuse to acute, the petioles 2.5–10 cm. long, sheathing to near the middle; peduncles exceeding the leaves; umbels 10–20-rayed, the fruiting rays spreading, 1–8.5 cm. long; involucel bracts linear-lanceolate, acute, sometimes connate, about equalling the greenish flowers (appearing white because of the pubescent petals); umbellets many-flowered, the fruiting pedicels 7–20 mm. long, mostly longer than the fruit; fruit orbicular to ovate-oblong, 8–15 mm. long, 7–10 mm. broad, the wings wider than the body, sparingly villous to glabrate, the body tomentulose to glabrate, the oil tubes 1–4 in the intervals, occasionally with smaller accessory oil tubes, 2–4 on the commissure, rarely one at the base of each wing.

Type: *Douglas*, California.

Distribution: Coast ranges, Lower California to Humboldt and Trinity counties, California.

Typical specimens: california: Potrero and Sausalito, *Kellogg & Harford 1156* (M, NY, US); hills 7 miles northeast of Santa Rosa, Sonoma Co., *Heller & Brown 5088a* (M, NY, Po, US); Klamath River, Humboldt Co., *Chandler 1445* (M, NY, UC, US).

32. Lomatium mohavense Coult. & Rose, Contr. U. S. Nat. Herb. 7: 234. 1900.

Peucedanum mohavense Coult. & Rose, Rev. N. Am. Umbell. 62. 1888.
P. argense Jones, Contr. Western Bot. 8: 30. 1898.
Lomatium argense (Jones) Coult. & Rose, Contr. U. S. Nat. Herb. 7: 234. 1900.
Cogswellia mohavensis (Coult. & Rose) Jones, Contr. Western Bot. 12: 34. 1908.
C. argensis (Jones) Coult. & Rose, Contr. U. S. Nat. Herb. 12: 449. 1909.

Plants acaulescent, 1–3 dm. tall, short hoary-pubescent, from a long slender tap-root; leaves oblong, the blades 2–9 cm. long, 3–4-pinnate, the leaflets crowded, linear, 2–5 mm. long, 0.5–1.5 mm. broad, mucronulate, the petioles 2.5–12 cm. long, longer than the leaf blades, shortly sheathing below; peduncles exceeding the leaves; umbels 10–16-rayed, the fruiting rays subequal, 1–4.5 cm. long; involucel bracts linear, acute, sometimes inconspicuously scarious-margined, shorter than to about equalling the fruiting pedicels; umbellets many-flowered, the flowers purple, the fruiting pedicels 1–10 mm. long; fruit ovate to orbicular, 4.5–9 mm. long, 4–9 mm. broad, the wings narrower than to equalling the body, the oil tubes 1–4 in the intervals, 4–6 on the commissure.

TYPE: *M. K. Curran*, Yucca, Mojave Desert, California (US fragment).

DISTRIBUTION: Deserts, southern California and adjacent Nevada, especially in the Mojave Desert.

TYPICAL SPECIMENS: NEVADA: Trail Canyon, White Mts., Esmeralda Co., *Duran 2701* (M, UC). CALIFORNIA: Walker Pass, *Purpus 5352* (M, UC, US); Darwin, *Jones* (M, NY, UC, US); Mojave Desert, near Hesperia, *Parish 4929* (US).

33. Lomatium tomentosum (Benth.) Coult. & Rose, Contr. U. S. Nat. Herb. 7: 219. 1900.

Peucedanum tomentosum Benth. Pl. Hartw. 312. 1849.
Cogswellia tomentosa (Benth.) Jones, Contr. Western Bot. 12: 35. 1908.

Plants short-caulescent, villous-tomentose throughout, 2.5–5 dm. tall, from a long slender tap-root; leaves oblong to obovate, the blades 5–11 cm. long, pinnately decompound or ternate, then quadripinnate, the leaflets crowded, filiform, 2–6 mm. long, 0.2–0.3 mm. broad, acute, sometimes apiculate, the petioles 4–9 cm. long, sheathing below; peduncles exceeding the leaves;

umbels 12–21-rayed, the fruiting rays subequal, 2.5–8.5 cm. long, spreading; involucel bracts lanceolate to ovate-lanceolate, distinct or connate below, acute to acuminate, entire or cleft above, equalling to exceeding the white or purplish flowers; umbellets many-flowered, the fruiting pedicels 5–20 mm. long, shorter than the mature fruit; fruit ovate-oblong, 16–22 mm. long, 8–18 mm. broad, tomentulose, the wings about equalling the body, tomentulose, the oil tubes 1–3 in the intervals, 3 on the commissure, usually 1 at the base of each wing.

TYPE: *Hartweg 257 (1751)*, "in amnibus exsiccatis fluviorum vallis, Sacramento," California, 1846–47.

DISTRIBUTION: Great Valley and Sierra Nevada foothills, and Tehachapi Mts., California.

TYPICAL SPECIMENS: CALIFORNIA: Wildcat Canyon, Stanislaus Co., *Stanford 860* (M, Po, US); Berry Canyon, near Clear Creek, Butte Co., *Heller & Brown 5552* (M, NY, Po, US); hills 8 miles north of Oroville, Butte Co., *Heller 11281* (M, NY, US).

34. Lomatium macrocarpum (Hook. & Arn.) Coult. & Rose, Contr. U. S. Nat. Herb. 7: 217. 1900, where the author of the name-bearing synonym is erroneously given as Nuttall.

Ferula macrocarpa Hook. & Arn. Bot. Beechey Voy. 348. 1840.
Peucedanum macrocarpum Nutt. ex Torr. & Gray, Fl. N. Am. 1: 627. 1840.
P. macrocarpum Nutt. var. ? *eurycarpum* Gray, Proc. Am. Acad. 8: 385. 1872.
P. eurycarpum (Gray) Coult. & Rose, Rev. N. Am. Umbell. 61. 1888.
Lomatium macrocarpum (Nutt.) Coult. & Rose var. *artemisiarum* Piper, Bull. Torrey Bot. Club 29: 223. 1902.
L. macrocarpum (Nutt.) Coult. & Rose var. *semivittatum* Piper, Bull. Torrey Bot. Club 29: 224. 1902.
L. flavum Suksd. Allg. Bot. Zeitschr. 12: 6. 1906.
L. artemisiarum Piper, Contr. U. S. Nat. Herb. 11: 423. 1906.
Cogswellia macrocarpa (Nutt.) Jones, Contr. Western Bot. 12: 33. 1908.
C. artemisiarum (Piper) Coult. & Rose, Contr. U. S. Nat. Herb. 12: 449. 1909.
C. flava (Suksd.) Coult. & Rose, Contr. U. S. Nat. Herb. 12: 449. 1909.
C. simulans Coult. & Rose, Contr. U. S. Nat. Herb. 12: 451. 1909.
Lomatium macrocarpum (Nutt.) Coult. & Rose var. *Douglasii* Jepson, Madroño 1: 153. 1924.
Cogswellia macrocarpa (Nutt.) Jones var. *artemisiarum* (Piper) St. John, Fl. S.E. Wash. & Adj. Ida. 292. 1937.

Plants short-caulescent, 1–5 dm. tall, densely tomentose to villous, becoming glabrate, purplish especially below, from a slender or somewhat swollen tap-root; leaves oblong to ob-

ovate, the blades 2.5–12 cm. long, ternate, then 2–3-pinnate, the leaflets confluent, oblong to linear, 1–7 mm. long, 0.5–2 mm. broad, entire, mucronulate, the petioles 1.5–7 cm. long, sheathing about to the middle, subscarious; peduncles exceeding the leaves; umbels 5–25-rayed, the rays spreading, 1–8.5 cm. long; involucel bracts dimidiate, linear-lanceolate, acute, equalling to greatly exceeding the white or yellow, sometimes purplish, flowers, becoming reflexed in the mature plant; umbellets many-flowered, the fruiting pedicels 1–14 mm. long, spreading; fruit narrowly oblong, 9–20 mm. long, 2–8 mm. broad; ovaries and young fruit glabrous to villous, the mature fruit glabrous or glabrate, the wings narrower than the body, the oil tubes 1, rarely 2–3, in the dorsal intervals, 1–3 in the lateral intervals, sometimes obscure, 2–6 on the commissure.

TYPE: *Douglas*, California.

DISTRIBUTION: Manitoba to North Dakota, west to British Columbia, south to Kern and Monterey counties, California.

TYPICAL SPECIMENS: YELLOWSTONE NATIONAL PARK: Yellowstone River, near Junction Butte, *Nelson & Nelson 5733* (M, NY, Po, US). WYOMING: 20 miles west of Big Piney, Sublette Co., *Payson & Payson 2633* (M, NY, Po, US). UTAH: Springville, *Jones* (M, NY, US). NEVADA: Palisade, *Jones 3883* (M, NY, Po, US). WASHINGTON: Pullman, *Elmer 96* (M, NY, US); Hangman Creek, Spokane Co., *Sandberg & Leiberg 61* (M, NY, Po, US). CALIFORNIA: near Lakeport, Lake Co., *Baker 2961* (M, NY, Po, US); near summit of Mt. Sanhedrin, Lake Co., *Heller & Brown 5947* (M, US).

This species is the most ubiquitous and most polymorphic in the genus.

34a. Lomatium macrocarpum (Hook. & Arn.) Coult. & Rose var. **ellipticum** (Torr. & Gray) Jepson, Madroño **1**: 153. 1924.

Peucedanum nudicaule Nutt. var. *ellipticum* Torr. & Gray, Pacific R.R. Rep. **2**[2]: 121. 1855.

Lomatium ellipticum (Torr. & Gray) Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 217. 1900.

Cogswellia elliptica (Torr. & Gray) Jones, Contr. Western Bot. **12**: 33. 1908.

Similar to the species but the pedicels sometimes longer, up to 16 mm. long; the fruit oblong-elliptic, 16–18 mm. long, 6–10 mm. broad, glabrous, the wings twice as broad as the body.

TYPE: *Snyder*, Round Valley, near the sources of the Sacramento, in the Sierra Nevada, California, 27 June 1854.

DISTRIBUTION: Northern Sierra Nevada, California.
SPECIMENS EXAMINED: CALIFORNIA: near Placerville, *K. Brandegee* (UC).

35. Lomatium Congdoni Coult. & Rose, Contr. U. S. Nat. Herb. 7: 232. 1900.

Cogswellia Congdoni (Coult. & Rose) Jones, Contr. Western Bot. 12: 34. 1908.

Plants acaulescent or short-caulescent (?), 1.8–3.6 dm. tall, from a cluster of old leaf sheaths, from a long tap-root; leaves broadly oblong, the blades 6.5–9 cm. long, ternate to quinate, then 2–3-pinnate, the rachises scaberulent, the leaflets distinct, linear, 3–10 mm. long, about 0.5 mm. broad, apiculate, the petiole 2–6 cm. long, entirely sheathing, white-scarious; peduncles exceeding the leaves, purplish, especially below; umbels 6–16-rayed, the fruiting rays 3–7 cm. long, ascending; involucel absent; umbellets about 30-flowered, the flowers yellow, the fruiting pedicels 6–10 mm. long; fruit oblong or somewhat obovate, 7–10 mm. long, 5–6 mm. broad, the wings about half the width of the body, the oil tubes obscure, mostly solitary in the intervals, 2–4 on the commissure.

TYPE: *Congdon 114*, West Water Ditch, Mariposa Co., California, 12, 25 May 1893 (US).
DISTRIBUTION: Known only from the type locality.
SPECIMENS EXAMINED: CALIFORNIA: Mariposa, *Congdon* (UC); West Water Ditch, Mariposa Co., *Congdon* (UC).

36. Lomatium Sandbergii Coult. & Rose, Contr. U. S. Nat. Herb. 7: 230. 1900.

Peucedanum Sandbergii Coult. & Rose, Bot. Gaz. 13: 79. 1888; Rev. N. Am. Umbell. 65. 1888.
Cogswellia Sandbergii (Coult. & Rose) Jones, Contr. Western Bot. 12: 35. 1908.

Plants caulescent, 0.7–3 dm. tall, rough-puberulent to glabrate, from a long slender tap-root; leaves suborbicular, the blades 3–7 cm. long, ternate, then tripinnate, the leaflets linear to filiform, 2–4 mm. long, about 0.5 mm. broad, entire, apiculate, the petioles 1–2.5 cm. long, entirely sheathing, the sheaths with a conspicuous white scarious margin; peduncles 1.5–15 cm. long; umbels 5–14-rayed, the fruiting rays unequal, 1–11.5 cm. long, erect; umbellets many-flowered, the fruiting pedicels 2–7

mm. long; involucel bracts filiform to linear, about equalling the yellow flowers; fruit oblong, 7–10 mm. long, 4–5 mm. broad, puberulent, the wings narrower than the body, the oil tubes 4–5 in the intervals, 6 on the commissure.

TYPE: *Sandberg 47*, "bare mountain tops along snowdrifts, Kootenai County, northern Idaho," July 1887 (US type coll.).

DISTRIBUTION: Western Montana and adjacent Idaho.

SPECIMENS EXAMINED: MONTANA: Columbia Falls, *Williams s. n.* (M, Po), *969* (M); McDougal Peak, *Jones s.n., 8620* (Po). IDAHO: Kootenai Co., *Sandberg* (M photo); Div. between St. Joe and Clearwater River, *Leiberg 1235* (M); open mountain slopes, ridges south from Wiesner's Peak, *Leiberg 1401* (M).

37. **Lomatium Torreyi** Coult. & Rose, Contr. U. S. Nat. Herb. 7: 229. 1900.

Peucedanum Torreyi Coult. & Rose, Bot. Gaz. 14: 276. 1889.
Cogswellia Torreyi (Coult. & Rose) Jones, Contr. Western Bot. 12: 35. 1908.

Plants acaulescent or caulescent, 1–2.5 dm. tall, glabrous to sparingly scaberulent, from a cluster of dried leaf sheaths; leaves oblong, the blades 2–15 cm. long, ternate, then tripinnate, the leaflets filiform, 3–8 mm. long, 0.2–1 mm. broad, entire, acute, mucronulate, the petioles 2–5 cm. long, sheathing throughout, the sheath with a white scarious margin; peduncles equalling or exceeding the leaves; umbels 5–9-rayed, the fruiting rays unequal, 1–4 cm. long, erect; involucels absent; umbellets 10–30-flowered, the flowers yellow, the fruiting pedicels 1–4 mm. long; fruit narrowly oblong, 10–16 mm. long, 3–4 mm. broad, narrowed toward the base, the wings less than one-half the width of the body, the oil tubes solitary in the intervals.

TYPE: *Torrey & Gray*, Yosemite Valley, California, is the first specimen cited in the original description. *M. K. Curran 16*, Yosemite Valley, June 1883, is given as the type in Contr. U. S. Nat. Herb. 7: 230. Described without name in Bot. Calif. 1: 263, as a plant closely allied to *Podosciadium*.

DISTRIBUTION: Clefts of granite rocks, Sierra Nevada Mts., from Fresno Co. to Tulare Co., California, 6000 to 11,000 feet.

SPECIMENS EXAMINED: CALIFORNIA: Mt. Moses, *Purpus 1531* (UC); Sentinel Dome, Yosemite National Park, *Schreiber 1720* (UC); Alta Meadows, Tulare Co., *K. Brandegee* (M, UC); Rock Creek Basin, Inyo Co., slope west of Long Lake, *Peirson 10771* (UC); road to Alta Meadows, *K. Brandegee* (UC); granite lakes, Granite Basin, Fresno Co., *Youngberg 155* (Po); Piute Pass, North Lake Trail, Inyo Co., *Ferris 8926* (Po).

38. Lomatium Engelmannii Mathias, spec. nov.

Planta acaulis, 1–3 dm. alta, pubescens; radicibus elongatis; foliis oblongis, petiolis excludentibus, 2.5–3.5 cm. longis, ternatis, deinde 1–2-pinnatis, foliolis confluentibus, ovato-oblongis, 1–4 mm. longis, 0.5–1 mm. latis, apiculatis, petiolis 2–4 cm. longis; pedunculis foliis longioribus; umbellis 2–7-radiatis, radiis inaequalibus, 1–5.5 cm. longis; umbellulis paucifloribus, sine involucellis, pedicellis 2–8 mm. longis; fructibus ovato-oblongis, 9–10 mm. longis, ca. 5 mm. latis, glabris, alis lateralibus angustis, jugis dorsalibus filiformibus, vittis 1–2 in intervallis, 2–6 in commissura.

Plants acaulescent, 1–3 dm. tall, pubescent, from a long slender tap-root; leaves oblong, the blades 2.5–3.5 cm. long, ternate, then 1–2-pinnate, the leaflets confluent, ovate-oblong, 1–4 mm. long, 0.5–1 mm. broad, apiculate, the petioles 2–4 cm. long, entirely sheathing, purplish; peduncles exceeding the leaves; umbels 2–7-rayed, the fruiting rays 1–4, unequal, 1–5.5 cm. long; involucel bracts absent; umbellets few-flowered, the flowers yellow (?), the fruiting pedicels 2–8 mm. long; fruit ovate-oblong, 9–10 mm. long, about 5 mm. broad, glabrous, the wings half the width of the body, the dorsal ribs filiform, the oil tubes 1–2 in the intervals, 2–6 on the commissure.

Type: *George Engelmann*, Scott's Mountain (Siskiyou Co.), northern California, 6000–7000 feet, 30 August 1880 (M 137292 type, 137293).

Distribution: Known only from the high mountains in southern Siskiyou Co., California.

Specimens examined: california: gravelly slope of Mt. Eddy, south of Wagon Creek, Siskiyou Co., *Heller 13676* (M).

39. Lomatium angustatum (Coult. & Rose) St. John, in St. John & Hardin, Mazama **11**: 83. 1929.

Peucedanum Martindalei Coult. & Rose var. *angustatum* Coult. & Rose, Bot. Gaz. **13**: 143. 1888.

Lomatium Martindalei Coult. & Rose var. *angustatum* Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 225. 1900.

Cogswellia Martindalei (Coult. & Rose) Jones var. *angustata* (Coult. & Rose) Jones, Contr. Western Bot. **12**: 34. 1908.

C. angustata Coult. & Rose, Contr. U. S. Herb. **12**: 449. 1909.

Lomatium Hallii of authors, not *Peucedanum Hallii* Wats. (1876).

Plants short-caulescent, 1.5–2 dm. tall, glabrous, from long slender tap-roots; leaves broadly oblong-ovate, the blades 6.5–15 cm. long, ternate, then 2–3-pinnate, the leaflets confluent and overlapping, ovate, 1–2 mm. long, 1–1.5 mm. broad, somewhat obtuse, minutely mucronulate, the petioles 1.5–3 cm. long, forming a conspicuous scarious sheath; peduncles exceeding the leaves; umbels 6–16-rayed, the rays unequal, 0.5–7 cm. long; involucels absent; umbellets about 20-flowered, the flowers creamy-white, the fruiting pedicels 1–6 mm. long; fruit narrowly oblong, 6–10 mm. long, 3–5 mm. broad, the wings very narrow, the oil tubes 1, rarely 2, in the intervals, 2–4 on the commissure.

TYPE: *Howell*, Cascade Mts., Oregon.

DISTRIBUTION: Mountains of western British Columbia to the Cascade Mts., Oregon, 3000 to 9000 feet.

TYPICAL SPECIMENS: WASHINGTON: Mt. Hermann, Whatcom Co., *Thompson 5319* (M, Th). OREGON: north slope, top of Black Butte, *Cusick 2687* (M, Po, UC); near summit of Cascade Mts. along McKenzie Pass, *Peck 9782* (M).

Lomatium angustatum differs from *L. Martindalei*, with which it has been confused, in having ternate-pinnate leaves, the fruit wings narrower than the body, the fruit less than 6 mm. broad, the pedicels shorter than the fruit (except in var. *flava* in the Olympic Mts.), and a narrowly oblong fruit. *Lomatium Martindalei* does not occur north of the Oregon Cascades. Neither of these species has any close relationship to *L. Hallii* (see note under that species), as has been supposed by all previous authors due to a misinterpretation and confusion in the type specimen of *L. Hallii*.

39a. Lomatium angustatum (Coult. & Rose) St. John var. **flavum** G. N. Jones, Univ. Wash. Publ. Biol. 5: 202. 1936.

Similar to the species but the leaves sometimes fleshier, flowers lemon-yellow, pedicels 8–16 mm. long.

TYPE: *Piper 897*, Olympic Mts., Washington.

DISTRIBUTION: Olympic Mts., Washington, 4500–6500 feet.

SPECIMENS EXAMINED: WASHINGTON: Iron Mt., near Marmot Pass, Jefferson Co., *Thompson 7958* (Th); bordering Honeymoon Meadows along west fork of the Dosewallips River and south base of Mt. Anderson, *Meyer 666* (Th); rocky crest of Constance Ridge, Jefferson Co., *Thompson 6590* (Th); rocky summit of Mt. Angeles, Clallam Co., *Thompson 5591* (M, Th); Clallam Co., *Elmer 2771* (M); al-

pine slopes of Mt. Angeles, Clallam Co., *Thompson 7464, 9445* (M, Po, Th, UC); rocky crevices at summit of Col. Bob Lookout, Grays Harbor Co., *Thompson 7259* (M, Th, UC).

40. **Lomatium Grayi** Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 229. 1900.

Peucedanum millefolium Wats. Bot. King Exp. 129. 1871, not Sonder (1861–62).
P. Grayi Coult. & Rose, Bot. Gaz. **13**: 209. 1888; Rev. N. Am. Umbell. 60. 1888.
P. Grayi Coult. & Rose var. *aberrans* Jones, Contr. Western Bot. **10**: 55. 1902.
Cogswellia millefolia (Wats.) Jones, Contr. Western Bot. **12**: 35. 1908.
C. Grayi Coult. & Rose, Contr. U. S. Nat. Herb. **12**: 450. 1909.
Lomatium millefolium (Wats.) Macbr. Contr. Gray Herb. n.s. **53**: 15. 1918.

Plants acaulescent or short-caulescent, 2–6.1 dm. tall, from a long thickened tap-root; leaves broadly obovate, the blades 10.5–26 cm. long, glabrous to somewhat scaberulent, 1–2-ternate or quinate, then 2–3-pinnate, the leaflets crowded, linear to filiform, 1–11 mm. long, 0.1–0.25 mm. broad, entire, mucronulate, the petioles 3.5–22 cm. long, sheathing at the base; peduncles exceeding the leaves; umbels 7–22-rayed, the rays spreading, 2–15 cm. long; involucel bracts filiform, entire, occasionally toothed, usually shorter than the yellow flowers, rarely deciduous; umbellets 15–30-flowered, the fruiting pedicels 6–22 mm. long; fruit ovate-oblong to oblong, 7–16 mm. long, 5–8 mm. broad, the wings narrower than to equalling the body, the oil tubes solitary in the intervals, rarely 2–3, especially in the lateral intervals, 2–4, rarely 6, on the commissure.

TYPE: *Watson 466*, Antelope Island, Salt Lake, Utah (US).

DISTRIBUTION: Western Wyoming and Colorado to eastern Washington and Oregon, 750 to 8400 feet.

TYPICAL SPECIMENS: IDAHO: about Lewiston, Nez Perce Co., *Heller & Heller 3043* (M, NY, Po). UTAH: gravel, Fairview, *Jones 5548* (M, NY, Po). WASHINGTON: Hangman Creek, Spokane Co., *Sandberg & Leiberg 5* (M, Po); shores of Snake River, Wawawai, *Piper 1767* (NY).

40a. **Lomatium Grayi** Coult. & Rose var. **depauperatum** (Jones) Mathias, comb. nov.

Cogswellia millefolia (Wats.) Jones var. *depauperata* Jones, Contr. Western Bot. **12**: 38. 1908.

Similar to the species but usually lower; leaves dissected into few remote small linear pinnae.

Type: *Jones*, Dugway, Utah, 2 June 1891 (Po 78055).
Distribution: Western Utah and adjacent Nevada.
Specimens examined: utah: Dugway, Dutch Mt., Tooele Co., Cove Creek, Detroit, Granite Mts., Tooele Co., Fish Spring, Oquirrh Mts., Deseret, *Jones* (Po); Marjim Canyon, 46 mi. w. of Delta, Millard Co., *Maguire & Becraft 3938* (UC). nevada: west of Wendover, *Jones 25253* (Po); Pilot Mt., White Pine Co., *Cottam 4533* (Po); *A. J. Jones* (M).

41. **Lomatium serpentinum** (Jones) Mathias, comb. nov.

Cogswellia serpentina Jones, Contr. Western Bot. **12**: 42. 1908.
C. fragrans St. John, Fl. S.E. Wash. & Adj. Ida. 290. 1937.

Plants acaulescent, 2.5–3 dm. tall, essentially glabrous, root thick and woody with a multicipital caudex; leaves oblong, the blade 8.5–15 (30?) cm. long, 1–2-ternate, then bipinnate, the leaflets crowded, lanceolate to oblanceolate, 2–5 mm. long, 1–2 mm. broad, entire, apiculate, minutely papillose above, the petioles 2–6 cm. long, partially to entirely sheathing with scarious-winged margins; peduncles exceeding the leaves; umbels 10–17-rayed, the fruiting rays unequal, 1.5–7 cm. long, spreading to ascending, glabrate; involucel bracts linear-lanceolate, up to 5 mm. long, finely puberulent; umbellets many-flowered, the flowers bright yellow, the fruiting pedicels 3–15 mm. long; fruit oblong, 6–8 (10?) mm. long, 3–4 (5?) mm. broad, glabrous, the wings one-half to equalling the width of the body, the oil tubes solitary in the intervals, 2 on the commissure.

Type: *Cusick 3532c*, rocky banks of the Snake River near the mouth of McDougal Creek, Oregon, 28 May 1901.
Distribution: Snake River Valley, Idaho, Washington, and Oregon.
Specimens examined: idaho: clefts in basaltic cliffs, above Steep Creek, 2 mi. n. of Sheep Creek, Snake River Canyon, Idaho Co., *Constance, Rollins & Dillon 1591* (Th, UC); basaltic ledges of Cottonwood Rapids, Snake River Canyon, Nez Perce Co., *Constance, Rollins & Dillon 1559* (UC); basalt ledges, rocky south slopes ½ mi. above mouth of Sheep Creek, Snake River Canyon, Idaho Co., *Constance, Herrick & Peters 1829* (UC).
Reported by St. John from Asotin Co., Washington.

42. **Lomatium Donnellii** Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 231. 1900.

Peucedanum Donnellii Coult. & Rose, Bot. Gaz. **13**: 143. 1888; Rev. N. Am. Umbell. 65. 1888.
Cogswellia Donnellii (Coult. & Rose) Jones, Contr. Western Bot. **12**: 34. 1908.

Plants acaulescent or caulescent with the development of a pseudoscape, 1.3–3.3 dm. tall, glabrous, from a long, some-

what stout tap-root; leaves ovate to oblong, the blades 4–10.5 cm. long, ternate then 2–3-pinnate, the leaflets more or less confluent, linear, 1–7 mm. long, 1–2 mm. broad, entire, acute, apiculate; the petioles 1–9 cm. long, sheathing below, sometimes entirely sheathing; peduncles exceeding the leaves; umbels 8–30-rayed, the fruiting rays unequal, 1–9 cm. long, spreading to suberect; involucel bracts filiform to linear-lanceolate, equalling the yellow flowers; umbellets about 20-flowered, the fruiting pedicels 3–15 mm. long; fruit ovate to ovate-oblong, 5–9 mm. long, 4–5 mm. broad, the wings less than half the width of the body, the oil tubes 3–6 in the intervals, 4–6 on the commissure.

TYPE: *Cusick 36*, Union Co., Oregon, May 1883, is the first specimen cited; *Howell 829* is given as the type in Contr. U. S. Nat. Herb. 7: 231.

DISTRIBUTION: Eastern Oregon.

SPECIMENS EXAMINED: OREGON: *Cusick 1587* (M, Po, UC); Prairie City, Grant Co., *Henderson 5183, 5185* (M); Fossil, Wheeler Co., *Henderson 5512* (M); hillsides of the Malheur, *Cusick 1622* (M, Po, UC); Silver Creek Valley, Harney Co., *Cusick 2615* (M, Po, UC).

43. Lomatium Nelsonianum Macbr. Contr. Gray Herb. n.s. **53**: 15. 1918.

Plants short-caulescent, about 4 dm. tall; leaves ovate, the blades up to 2.5 (?) dm. long, ternately to ternate-pinnately decompound, the leaflets linear or filiform (?), about 3 mm. long, less than 0.5 mm. broad, glabrous or sparingly hispid (?), the petioles 2.5–5 cm. long, sheathing below; peduncles exceeding the leaves; umbels 12–15-rayed, the rays unequal, ascending, 2.5–7 cm. long; involucel bracts filiform, sparingly hispid, up to half the length of the pedicels; umbellets 15–20-flowered, the flowers yellow (?), the fruiting pedicels 10–16 mm. long, minutely pubescent to glabrate, spreading; fruit oblong, 7–9 mm. long, 4–5 mm. broad, the wings slightly narrower than the body, the oil tubes 3 in the intervals, 6 on the commissure.

TYPE: *J. C. Nelson 1419*, dry rocky hillside near Mule Creek, Curry Co., Oregon, 21 June 1917 (G).

DISTRIBUTION: Known only from the type collection.

This species is inadequately known. The detached leaves on the type sheet are probably leaves of *Leptotaenia dissecta.*

They show the characteristic pubescence of that species, while the leaves attached to the stems of the plant are apparently glabrous. The stem leaves are so badly withered that it is difficult to study them but the leaflets seem to be a somewhat different shape from those of the detached leaves.

44. Lomatium minimum Mathias, comb. nov.

Cogswellia minima Mathias, Ann. Mo. Bot. Gard. **19**: 497. 1932.

Plants acaulescent, 1–3.5 cm. tall, glabrous or scabrous-puberulent; leaves narrowly oblong, the blades 0.5–2.5 cm. long, simply pinnate with 4–6 pairs of acute, distinct, entire or once-lobed leaflets, 2–10 mm. long, 1–1.5 mm. broad, the petiole 1–6 mm. long, entirely sheathing; peduncles equalling or slightly exceeding the leaves; umbels few-rayed, the rays unequal, 3–12 mm. long; involucel bracts subdimidiate, several, more or less distinct, narrow, acute, foliaceous, somewhat scarious-margined, shorter than to equalling the yellow flowers; umbellets few-flowered, the pedicels 1–2 mm. long; fruit oblong, 4–7 mm. long, 3–4 mm. broad, glabrous, the wings well-developed, about equalling the body, the oil tubes more or less obsolete.

TYPE: *Mathias 670*, near the hotel, dry slopes bordering Bryce Canyon, Utah, 8600 feet, 18 July 1929 (M).

DISTRIBUTION: Known only from the type locality and the Panguitch Plateau above Cedar Breaks, southwestern Utah.

SPECIMENS EXAMINED: UTAH: Cedar Breaks, *Jones* (Po); Panguitch, *Jones* (Po); on the edge of the Breaks, between the hotel and the camp ground, Cedar Breaks, near Cedar City, Iron Co., *Mathias 734* (M).

45. Lomatium oreganum Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 224. 1900.

Peucedanum oreganum Coult. & Rose, Rev. N. Am. Umbell. 64. 1888.
Cogswellia oregana (Coult. & Rose) Jones, Contr. Western Bot. **12**: 35. 1908.

Plants very low, acaulescent, 2.5–6 cm. tall, villosulose throughout, from a multicipital woody caudex; leaves oblong, the blades 1–3 cm. long, bipinnate, the leaflets crowded, oblong, 2–3 mm. long, about 1 mm. broad, apiculate, the petioles 0.5–2 cm. long, sheathing below; peduncles exceeding the leaves; umbels greatly reduced, with one fertile umbellet, the fertile

rays 1–5 mm. long, and 2–3 sessile sterile umbellets; involucel bracts linear, acute, not scarious-margined, longer than the yellow flowers; umbellets few-flowered, the fruiting pedicels 1–1.5 mm. long; fruit oblong, about 5 mm. long, 2.5 mm. broad, villosulose, the wings much narrower than the seed, the oil tubes 2–3 in the intervals, 4 on the commissure.

TYPE: *Cusick 1390*, alpine rocks, Blue and Eagle Creek Mts., Oregon, Aug. 1886–88 (F).

DISTRIBUTION: Known only from the type localities.

SPECIMENS EXAMINED: OREGON: cliff-sides of highest Blue Mts., head of Anthony's Creek, *Cusick 2247* (UC).

46. Lomatium Greenmanii Mathias, spec. nov.

Planta caulescens, 5–8 cm. alta; foliis oblongis, petiolis excludentibus, 1.5–2.5 dm. longis, 1–2-pinnatis, foliolis oblongis, 5–10 mm. longis, 2–2.5 mm. latis, apiculatis, marginibus subscabris, petiolis 1.5–3 cm. longis, folio caulino unico, parvo, pinnato; pedunculis foliis longioribus; umbellis cum 1–3 umbellulis fertilibus, radiis 1.5–2 mm. longis; bracteis involucelli paucis, filiformibus, ca. pedicellis aequalibus; umbellulis paucifloribus, pedicellis ca. 1 mm. longis, ovariis fructibusque glabris; fructibus ovatis, 3–5 mm. longis, 2 mm. latis, alis angustis, jugis dorsalibus filiformibus, vittis 1 in intervallis, 2 in commissura.

Plants low, caulescent, 5–8 cm. tall, from a multicipital woody caudex; leaves oblong, the blades 1.5–2.5 cm. long, 1–2-pinnate, the leaflets oblong, distinct, 5–10 mm. long, 2–2.5 mm. broad, apiculate, the margins slightly roughened, the petioles 1.5–3 cm. long, purplish sheathing below, the single stem leaf much reduced, pinnate, the petiole purplish, sheathing throughout; peduncles exceeding the leaves; umbels reduced to 1–3 fertile umbellets and 1–2 sessile sterile umbellets, the fruiting rays 1.5–2 mm. long; involucel bracts few, filiform, white-scarious, about equalling the pedicels; umbellets few-flowered, the flowers white, the fruiting pedicels about 1 mm. long, the ovaries glabrous; fruit ovate, 3.5 mm. long, 2 mm. broad, glabrous, the wings much narrower than the body, the dorsal ribs filiform, the oil tubes solitary in the intervals, 2 on the commissure.

TYPE: *Cusick 2458*, Wallowa Mts., head of Keystone Creek, 9000 feet, Oregon, fruiting August 4, 1900 (Po 78156).
DISTRIBUTION: Known only from the type collection.

This species is named in honor of Dr. J. M. Greenman, of the Missouri Botanical Garden, who first suggested to the writer the interesting problems in the study of this genus and whose advice and assistance has been greatly valued.

47. **Lomatium Eastwoodae** (Coult. & Rose) Macbr. Contr. Gray Herb. n.s. **56**: 35. 1918.

Cynomarathrum Eastwoodae Coult. & Rose, Contr. U. S. Nat. Herb. 7: 247. 1900.
Cogswellia Eastwoodae (Coult. & Rose) Jones, Contr. Western Bot. 12: 35. 1908.

Plants acaulescent, 1–1.5 dm. tall from a subwoody caudex covered with old leaf sheaths; leaves narrowly oblong, scaberulent, the blades 2.5–7 cm. long, 1–2-pinnate, with 5–7 remote pairs of segments, the leaflets oblong-lanceolate, 2–4 mm. long, 1–1.5 mm. broad, crowded, apiculate, the petioles 1.5–4.5 cm. long, shortly sheathing below; peduncles exceeding the leaves; umbels 4–6-rayed, the fruiting rays unequal, 1–3 cm. long, ascending; involucel bracts few, linear, entire, much shorter than the pedicels; umbellets 2–15-flowered, the flowers yellow (?), the fruiting pedicels 6–17 mm. long, ascending; fruit oblong, 8–10 mm. long, about 6 mm. broad, glabrous, the wings equalling to broader than the body, the oil tubes 3–4 in the intervals, 6–8 on the commissure.

TYPE: *Eastwood*, Grand Junction, Colorado, May 1892 (US).
DISTRIBUTION: Known only from the type locality.
SPECIMENS EXAMINED: COLORADO: Grand Junction, *Bethel* s. n. (Cl), *24* (US), *Jones* (Po), *Eastwood* (UC).

48. **Lomatium scabrum** (Coult. & Rose) Mathias, comb. nov.

Cynomarathrum scabrum Coult. & Rose, Contr. U. S. Nat. Herb. 7: 247. 1900.
Cogswellia scabra (Coult. & Rose) Jones, Contr. Western Bot. 12: 35. 1908.

Plants acaulescent, 1–3.5 dm. tall, from a subwoody caudex covered with old leaf sheaths; leaves narrowly oblong, the blades 5.5–10 cm. long, sparsely to densely scaberulent, 2–3-pinnate, the leaflets crowded, linear, 2–4 mm. long, 1–1.5 mm.

broad, apiculate, the petioles 3–10 cm. long, sheathing below, glabrous to scaberulent; peduncles exceeding the leaves, sparsely scaberulent to glabrate, especially above; umbels 7–14-rayed, the fruiting rays 1.5–4 cm. long, ascending, glabrous; involucel bracts distinct or shortly connate, linear, setaceous, shorter than to equalling the yellow flowers; umbellets many-flowered, the fruiting pedicels 5 (2 ?)–9 mm. long, ascending; fruit oblong-ovate, 7–9 mm. long, 4–6 mm. broad, glabrous, the wings less than to half the width of the body, the oil tubes 3–5 in the intervals, 4–10 on the commissure.

Type: *Jones 1864,* Frisco, Utah, 2400 m., 22 June 1880 (US type, Po).
Distribution: Southwestern Utah.
Specimens examined: utah: St. George, *Jones 1615* (Po); Detroit, Silver Reef, Frisco, *Jones* (Po); Cedar Canyon, Iron Co., *Cottam, Stanton & Harrison 3935* (Po); Copper Mine, *Jones 5006b* (Po); St. George, *Jones 5110o* (Po, UC); Diamond Valley, *Jones 5125g* (Po, US); St. George, *Gooding 799* (M, UC); Leeds, *Tidestrom 9391* (US).

49. Lomatium ciliolatum Jepson, Madroño 1: 155. 1924; Man. Fl. Pl. Calif. 723. 1925.

Plants acaulescent, about 1.5 dm. tall, from a long slender tap-root; leaves ovatish, 2–3.5 cm. long, margins finely and regularly ciliolate, pinnate, the leaflets 0.8–2 cm. long, irregularly pinnatifid into ovatish segments; peduncles exceeding the leaves; umbels 3–5-rayed, the rays unequal, 0.8–3.2 cm. long; involucel bracts several, ovate, with dark purple veins; umbellets few-flowered, the pedicels 2–4 mm. long; fruit elliptic, 7–8 mm. long, glabrous, the wings narrow, the oil tubes obscure, 4–5 in the intervals, 2 on the commissure.

No material of this species has been seen and this description has been adapted from those published by Jepson.

Type: *Jepson (14319),* Soldiers Ridge near South Yollo Bolly, California.
Distribution: Known only from the type locality, California.

50. Lomatium concinnum (Osterh.) Mathias, comb. nov.

Cogswellia concinna Osterh. Muhlenbergia 8: 44. 1912.

Plants short-caulescent, 1.2–2.5 dm. tall, glabrous, purplish below, from a long slender tap-root; leaves oblong, the blades 2–7 cm. long, bipinnate with the lower leaflets sometimes pin-

nately lobed, the leaflets distinct, linear, 2–11 mm. long, 1–2 mm. broad, rounded at the apex, sometimes apiculate, the petioles 1.5–5.5 cm. long, sheathing below; peduncles exceeding the leaves; umbels 8–13-rayed, the fruiting rays 5–6, subequal, 2.5–4 cm. long, spreading; involucel bracts conspicuous, dimidiate, foliaceous, ovate-lanceolate, acute, entire or rarely lobed towards the apex, usually many-nerved, connate below, equalling to longer than the yellow flowers; umbellets many-flowered, the fruiting pedicels 1–2 mm. long; fruit ovate, 5–8 mm. long, 4–5 mm. broad, the wings less than half the width of the body, the oil tubes 4–5 in the intervals, about 10 on the commissure.

TYPE: *Osterhout 4515*, Paeonia, Delta Co., Colorado, 21 May 1911 (NY, Po type coll.).

DISTRIBUTION: Southwestern Colorado.

SPECIMENS EXAMINED: COLORADO: Cimarron, *Baker 22* (M, Po, UC); north fork of the Gunnison, *Purpus 587* (UC).

51. Lomatium Parryi (Wats.) Macbr. Contr. Gray Herb. n.s. **56**: 35. 1918.

Peucedanum macrocarpum Parry, Am. Nat. 9: 272. 1875, nom. nud., not Nutt. (1840).
P. Parryi Wats. Proc. Am. Acad. 11: 143. 1876.
P. scopulorum Jones, Contr. Western Bot. 8: 31. 1898.
Cynomarathrum Parryi (Wats.) Coult. & Rose, Contr. U. S. Nat. Herb. 7: 246. 1900.
Cogswellia Parryi (Wats.) Jones, Contr. Western Bot. 12: 32. 1908.
Lomatium Parryi (Wats.) Jepson, Madroño 1: 157. 1924, in err.
Cogswellia Cottami Jones, Contr. Western Bot. 16: 36. 1930.

Plants acaulescent, glabrous, 2–4 dm. tall, from a long somewhat stout tap-root; leaves narrowly oblong, the blade 10–20 cm. long, 2–3-pinnate, the lowermost pinnae more divided than the upper, the leaflets linear, 2–9 mm. long, about 1 mm. broad, entire, cuspidate, the petioles 6–10.5 cm. long, short-sheathing; peduncles clustered from the old sheaths, equalling to somewhat exceeding the leaves; umbels about 15-rayed, the rays subequal, 2–4.5 cm. long, suberect; involucel bracts several, linear, acute, subscarious, sometimes cleft, equalling or exceeding the yellow flowers; umbellets about 10-flowered, the fruiting pedicels 10–17 mm. long; fruit oblong, 9–12 mm. long, 4–6 mm.

broad, the wings equalling or somewhat wider than the body, the oil tubes 2–3 in the intervals, 4 on the commissure.

TYPE: *Parry 85,* southern Utah (G).

A mixture of material was distributed under *Parry 85;* the type of this species is a glabrous specimen.

DISTRIBUTION: Mountain ranges, southeastern Utah to the Panamint Mts., California.

SPECIMENS EXAMINED: UTAH: Sierra La Sal, *Purpus* (M, UC, US); Apex Mine, Beaver Dam Mts., Washington Co., *Cottam 4098* (M, Po type of *C. Cottami*); *Palmer 178* (M); Silver Reef, *Jones 5149s* (M, Po, US). NEVADA: Meadow Valley Wash, *Goodding 629* (M, US); Duck Creek Canyon, 4 mi. s. e. of Paine's Ranch, *A. E. Hitchcock 1402* (US). CALIFORNIA: Surprise Canyon, Panamint Mts., Inyo Co., *Howell 3898* (M); Pleasant Canyon, Panamint Mts., *Jones* (M type coll. of *P. scopulorum*); head of Wild Rose Canyon, Panamint Mts., *Mathias 827* (M).

52. Lomatium Nuttallii (Gray) Macbr. Contr. Gray Herb. n.s. **56**: 35. 1918.

Seseli Nuttallii Gray, Proc. Am. Acad. **8**: 287. 1870, in part.

Peucedanum graveolens Wats. Bot. King Exp. 128. 1871, not Benth. & Hook. (1867).

P. Kingii Wats. Proc. Am. Acad. **22**: 474. 1887.

Cynomarathrum Nuttallii (Gray) Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 245. 1900.

Cogswellia Nuttallii (Gray) Jones, Contr. Western Bot. **12**: 32. 1908.

Plants acaulescent, glabrous, 1.5–4.2 dm. tall, from a multicipital subwoody caudex covered with old leaf sheaths; leaves oblong, the blades 5.5–13 cm. long, 1–2-pinnate or ternate- or quinate-pinnate, the leaflets remote, linear, 10–50 mm. long, 1–2 mm. broad, entire, cuspidate, the petioles 3–15 cm. long, shortly sheathing below; peduncles stout, usually greatly exceeding the leaves in the mature plant; umbels 5–16-rayed, the fruiting rays 15–43 mm. long, erect to suberect; involucel bracts distinct or shortly connate, linear, acute to acuminate, entire or once-lobed near the base, longer than or equalling the yellow flowers, sometimes reflexed; umbellets 15–20-flowered, the fruiting pedicels 3–7 mm. long, suberect; fruit narrowly oblong, 9–13 mm. long, 3–4 mm. broad, the wings about half the width of the body, the oil tubes 3–5 in the intervals, 6–10 on the commissure.

TYPE: *Nuttall,* Rocky Mountains.

DISTRIBUTION: Southwestern Wyoming to northwestern New Mexico and eastern Nevada, with one collection from Nebraska (*Rydberg 129*, Scotts Bluff in the Pass [US]).

TYPICAL SPECIMENS: WYOMING: lower slopes, Piney Mt., 25 miles west of Big Piney, Sublette Co., *Payson & Payson 2707* (M, Po, UC, US). UTAH: clay slopes near Mill Creek, foothills of Uinta Mts., Summit Co., 8200 ft., *Payson & Payson 4807* (M, US), *4887* (Po, UC).

52a. Lomatium Nuttallii (Gray) Macbr. var. alpinum (Wats.) Mathias, comb. nov.

Peucedanum graveolens Wats. var. *alpinum* Wats. Bot. King Exp. 129. 1871.
P. Kingii Wats. var. *alpinum* (Wats.) Coult. & Rose, Rev. N. Am. Umbell. 71. 1888.
Cynomarathrum alpinum (Wats.) Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 245. 1900.
Cogswellia Nuttallii (Gray) Jones var. *alpina* (Wats.) Jones, Contr. Western Bot. **12**: 32. 1908.
Lomatium alpinum (Wats.) Macbr. Contr. Gray Herb. n.s. **56**: 35. 1918.

Similar to the species but usually lower, up to 3 dm. tall; leaves usually less divided; rays 3–6; pedicels 4–10 mm. long.

TYPE: *Watson 464*, East Humboldt Mts., Nevada (US).

DISTRIBUTION: Western Utah and adjacent Nevada.

SPECIMENS EXAMINED: UTAH: Gold Hill, Black Mt., *Jones* (Po). NEVADA: Shellbourne, Osceola, Duck Creek, Muncy, *Jones* (Po); Glencoe, *Jones* (Po, US); rocky slopes, Highland Peak, *Purpus 6282* (Po, UC, US); 7 mi. east of Ely, *A. E. Hitchcock 1313* (US).

53. Lomatium Hallii (Wats.) Coult. & Rose, Contr. U. S. Nat. Herb. 7: 224. 1900.

Peucedanum nudicaule Gray, Proc. Am. Acad. **8**: 385. 1872, not Nutt. (1840).
P. Hallii Wats. Proc. Am. Acad. **11**: 141. 1876.
P. microcarpum Howell ex Coult. & Rose, Rev. N. Am. Umbell. 65. 1888.
Lomatium Leibergii Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 224. 1900.
L. microcarpum (Howell) Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 230. 1900.
Cogswellia Hallii (Wats.) Jones, Contr. Western Bot. **12**: 35. 1908.
C. microcarpa (Howell) Jones, Contr. Western Bot. **12**: 35. 1908.
C. Leibergii (Coult. & Rose) Jones, Contr. Western Bot. **12**: 35. 1908.

Plants short-caulescent, 2.0–3.5 dm. tall, glabrous except for an occasional slight scaberulence in the inflorescence; leaves oblong, the blades 4.5–10 cm. long, tripinnate, the leaflets distinct except the uppermost, linear or oblong, 2–4 mm. long, less than 1 mm. broad, entire, apiculate, the petioles 3–6 cm.

long, sheathing to about the middle, the sheath scarious-margined, purplish; fruiting peduncles exceeding the leaves; umbels 9–17-rayed, the rays unequal, 1.3–5 cm. long, spreading, glabrous or scaberulent below; involucel bracts linear-lanceolate, acuminate, equalling the yellow flowers; umbellets about 30-flowered, the fruiting pedicels 4–7 mm. long, glabrous or scaberulent; fruit oblong, 5–7 mm. long, about 3 mm. broad, the wings about one-half the width of the body, the oil tubes 2–3 in the intervals, 5 on the commissure.

TYPE: *Hall 211*, "Oregon" (probably Silver Creek, Marion Co.) (G type, NY).

DISTRIBUTION: River valleys, western slopes of the Cascade Mts., Oregon.

SPECIMENS EXAMINED: OREGON: on cliffs, Roseburg, Umpqua Valley, Howell (M, NY, Th); rocky bluff near Myrtle Creek, Douglas Co., *Thompson 10174* (NY, Th); *Leiberg 4166* (collection of 1899) (US type of *L. Leibergii);* moist bluffs, edge of coniferous woods, 2 mi. above Oakridge, Middle Fork of Willamette River, Cascade Mts., Lane Co., *Constance, Henderson & Rollins 1471* (Th, UC).

The specimens of Howell without number cited above agree in date of collection and locality with *Howell 709*, the type of *Peucedanum microcarpum*, and are a perfect match for the type specimen of *P. Hallii*, *Hall 211* in part.

The type sheet of *Peucedanum Hallii* in the Gray Herbarium has mounted on it five distinct plants. Two of these plants have finely cut leaves, nearly mature fruit and 3 oil tubes in the intervals. These are to be considered the type of the species. The other three specimens may belong together and are *Lomatium angustatum.* The specimens of *Hall 211* have been distributed as coming variously from Mt. Hood and from Silver Creek, Marion County, Oregon. The specimens of *L. angustatum* may well have been collected at Mt. Hood. Because of the Mt. Hood locality it has been generally considered that *L. Hallii* was an alpine plant and consequently it has been misunderstood and in most cases confused with *L. angustatum.*

The collection of Leiberg *(4166* in 1899), the type of *Lomatium Leibergii,* was probably made in the valleys on the western slopes of the Cascades since we have records of other collections by Leiberg in the summer of 1899 from that region, namely, from east of Medford, Abbott Butte, Big Butte Creek, Lower Applegate Creek, and Ashland.[1]

54. Lomatium Martindalei Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 225. 1900.

Peucedanum Martindalei Coult. & Rose, Bot. Gaz. **13**: 142. 1888; Rev. N. Am. Umbell. 66. 1888.

Cogswellia Martindalei (Coult. & Rose) Jones, Contr. Western Bot. **12**: 34. 1908.

---

[1] C. P. Smith, A distributional catalogue of the lupines of Oregon. Contr. Dudley Herb. 1(1). 1927.

Plants short-caulescent, purplish, 1.5–2.5 dm. tall, from a long, somewhat thickened tap-root; leaves oblong to ovate-oblong, the blades 2.5–5 cm. long, 1–2-pinnate, minutely roughened to glabrous on the margins and veins below, the leaflets oblong to cuneate, 5–10 mm. long, 2–7 mm. broad, pinnately lobed to serrate above, the petioles 2.5–5 cm. long, sheathing below; peduncles exceeding the leaves; umbels 4–7-rayed, the fruiting rays unequal, 1–5.5 cm. long, suberect; involucel bracts few, filiform, shorter than the pedicels; umbellets 10–20-flowered, the fruiting pedicels 2–3, 7–10 mm. long; fruit oblong, 13–16 mm. long, 7–8 mm. broad, the wings about equalling the body, the oil tubes solitary in the intervals, 2 on the commissure.

TYPE: *Howell*, "rocky places, Cascade Mountains, Oregon," May–June 1880.
DISTRIBUTION: Cascade Mts., Oregon.
SPECIMENS EXAMINED: OREGON: Coral Springs, *Leiberg 609* (UC); rocky places, Cascade Mountains, *Howell* (NY type coll.); alpine slopes of Crater Lake, Klamath Co., *Thompson 12286* (Th); Wizard Island, Crater Lake, *Heller 13462* (M).

55. **Lomatium latilobum** (Rydb.) Mathias, comb. nov.

Cynomarathrum latilobum Rydb. Bull. Torrey Bot. Club **40**: 73. 1913.

Plants acaulescent, 0.8–1.8 dm. tall, glabrous, from a semi-woody deep-seated root, caudex multicipital, broadly caespitose, the branches several, clothed with old leaf sheaths; leaves several from each crown, erect, oblong, the blades 2–8 cm. long, pinnate, rarely bipinnate, the leaflets lanceolate, sessile, in 3–5 pairs, 3–30 mm. apart, 5–28 mm. long, 2–6 mm. broad, entire, acute, mucronulate, the petioles 2–10.5 cm. long, shortly sheathing below; peduncles equalling to exceeding the leaves; umbels 4–10-rayed, the fruiting rays 2–5, subequal, 5–12 mm. long, spreading; involucel bracts dimidiate, distinct or connate below, linear to lanceolate, acute, prominently nerved, mostly exceeding the pedicels, sometimes reflexed; umbellets few-flowered, the flowers yellow (?), the fruiting pedicels 1–4 mm. long; fruit oblong, 7–12 mm. long, 3–5 mm. broad, the wings narrower than to equalling the body, the oil tubes 1–2 in the intervals, 2–4 on the commissure.

TYPE: *Rydberg & Garrett 8371,* proposed dam site, near Wilson Mesa, Grand Co., Utah, 1 July 1911, (NY type, Garrett, US).

DISTRIBUTION: Southeastern Utah.

SPECIMENS EXAMINED: UTAH: Moab, *Jones* (Po); Sierra La Sal, *Purpus* (Po), *Purpus 7150* (Po, UC).

56. Lomatium megarrhizum (A. Nels.) Mathias, comb. nov.

Musenium tenuifolium acc. to Hook. Lond. Jour. Bot. 6: 237. 1847, not Nutt. (1840).

Peucedanum megarrhiza A. Nels. Bull. Torrey Bot. Club 26: 130. 1899.

Cynomarathrum megarrhizum A. Nels. ex Rydb. Fl. Rocky Mts. 629, 1064. 1917.

Plants acaulescent, 1–3 dm. tall, glabrous, clustered from a broad, semi-woody, deep-seated root, the caudex multicipital, broadly caespitose, the branches numerous, crowded, thickly clothed with old leaf sheaths; leaves few to several from each crown, rigidly erect, linear-oblong, the blades 5.5–9.5 cm. long, pinnate, the leaflets in 2–5 remote pairs, 11–25 mm. long, about 1 mm. broad, entire and narrowly linear, cuspidate to irregularly and remotely pinnatified, the segments few, linear, 1–10 mm. long, 1 mm. broad, cuspidate, the petioles 4.5–8 cm. long, shortly sheathing below; peduncles equalling to shortly exceeding the leaves; umbels 10–11-rayed, the rays all fertile, subequal, 8–23 mm. long, spreading to reflexed; involucel bracts connate below, subdimidiate, linear, acute to short-acuminate, longer than the pedicels; umbellets about 20-flowered, the flowers yellow, the fruiting pedicels 1–2 mm. long, spreading to reflexed; fruit oblong, 5–8 mm. long, 2.5–3 mm. broad, the wings narrower than the body, the oil tubes about 3 in the intervals, 6–10 on the commissure.

TYPE: *Nelson 4769,* Point of Rocks, Wyoming, 16 June 1898.

DISTRIBUTION: Southwestern Wyoming.

SPECIMENS EXAMINED: WYOMING: Upper Platte, *Geyer 220* (M photo); Point of Rocks, *Nelson 4769* (M type coll.); Carter, Uinta Co., *Goodding 1186* (M, Po, UC, US); shale slopes, 6 mi. east of Big Piney, *Payson & Payson 2596* (M, Po, UC, US); Steamboat Mt., Sweetwater Co., *Nelson 7080* (M, Po, US); rim of Botes Hole, *Payson & Payson 4725* (M).

57. Lomatium simplex (Nutt.) Macbr. Contr. Gray Herb. n.s. 56: 34. 1918.

Peucedanum triternatum (Pursh) Nutt. var. *platycarpum* Torr. Stansb. Rep. 389. 1852.

P. triternatum Torr. acc. to Sitgreaves Rep. 160. 1853, not Nutt. (1840).
P. simplex Nutt. ex Wats. Bot. King Exp. 129. 1871.
Lomatium platycarpum (Torr.) Coult. & Rose, Contr. U. S. Nat. Herb. 7: 226. 1900, as to glabrous fruit forms.
Cogswellia platycarpa (Torr.) Jones, Contr. Western Bot. 12: 32. 1908.
C. simplex (Nutt.) Jones, Bull. Univ. Mont. Biol. Ser. 15: 41. 1910.
C. simplex (Nutt.) Rydb. Bull. Torrey Bot. Club. 40: 74. 1913, in err.

Plants caulescent or acaulescent, 2–6 dm. tall, clustered from a long slender tap-root; stems mostly simple, few-leaved, densely puberulent; leaves obovate, the blades 11–20 cm. long, biternate, the leaflets linear, acute, 2.5–11.5 cm. long, 3–6 mm. broad, glabrous above, glabrous to densely puberulent below, the petioles glabrous to puberulent, 6–14 cm. long, sheathing to near the middle; peduncles densely puberulent, exceeding the leaves; umbels 8–17-rayed, the rays unequal, 1.5–5.8 cm. long, spreading to ascending; involucel bracts linear or filiform, acute to acuminate, glabrous or puberulent, shorter than the pedicels; umbellets 10–30-flowered, the flowers yellow, the fruiting pedicels 1–9 mm. long; fruit broadly oblong to sub-orbicular, 7–14 mm. long, 7–10 mm. broad, the wings broader than the body, the oil tubes solitary in the intervals, 2 on the commissure.

TYPE: *Nuttall,* Rocky Mts. (Ph).

DISTRIBUTION: Western Montana to Utah, southwestern Colorado, west to Washington and Oregon.

TYPICAL SPECIMENS: IDAHO: Shoshone Falls, *Macbride 1722* (M, UC). UTAH: Goodman Ranch, Bear River, Summit Co., *Payson & Payson 4866* (M). WASHINGTON: *Canby 798* (UC).

According to Section 6, Article 49 of the International Rules of Botanical Nomenclature "When . . . a subdivision becomes a species, . . . the earliest name received by the group in its new position must be regarded as valid. . . ." Thus the specific name *simplex* must be used instead of *platycarpa.*

57a. Lomatium simplex (Nutt.) Macbr. var. **leptophyllum** (Hook.) Mathias, comb. nov.

Peucedanum triternatum (Pursh) Nutt. var. *leptophyllum* Hook. Lond. Jour. Bot. 6: 235. 1847.
Cogswellia leptophylla (Hook.) Rydb. Bull. Torrey Bot. Club 40: 74. 1913.

Similar to the species but the ovaries and young fruit puberulent.

TYPE: *Geyer 505,* "crevices of Trappe masses, on the slopes of the high plains of Kooskooskee River," Idaho, July.

DISTRIBUTION: Western Montana and Wyoming to British Columbia, eastern Washington, and Oregon.

TYPICAL SPECIMENS: MONTANA: Missoula, *Kirkwood 1730* (UC, UM), *2424* (Po, UM); Hamilton, *Blankinship 705* (M, UC, UM). WYOMING: Green River Lakes, Sublette Co., *Payson & Payson 4454* (M). IDAHO: Boise, *Clark 40* (M, NY, UC).

58. Lomatium triternatum (Pursh) Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 227. 1900.

Seseli triternatum Pursh, Fl. 1: 197. 1814.

Eulophus triternatus (Pursh) Nutt. Jour. Acad. Philad. 7: 27. 1834.

Peucedanum triternatum (Pursh) Nutt. ex Torr. & Gray, Fl. N. Am. 1: 626. 1840.

Seseli biternatum Pursh, ex Torr. & Gray, Fl. N. Am. 1: 626. 1840, err. in synon.

Peucedanum Nuttallii Walp. Rep. 2: 411. 1843, not *Seseli Nuttallii* Gray (1870).

Cogswellia triternata (Pursh) Jones, Contr. Western Bot. **12**: 32. 1908.

Plants caulescent or acaulescent, 1.7–8 dm. tall, puberulent to glabrate, from a long slender tap-root; leaves broadly obovate, the blades 7–15 cm. long, ternate or quinate, then pinnate to bipinnate, the leaflets few, linear, 1.5–12.6 cm. long, 0.5–7 mm. broad, entire, acute, the petioles 7–20 cm. long, sheathing about to the middle, purplish below, the stem leaves 1–2, smaller, the petioles entirely sheathing; peduncles exceeding the leaves; umbels 10–20-rayed, the fruiting rays unequal, 1.2–5.5 cm. long, spreading to suberect; involucel bracts several, filiform, about equalling the pedicels; umbellets many-flowered, the flowers yellow, the ovaries glabrous, the fruiting pedicels 3–5 mm. long; fruit oblong, 9–13 mm. long, 3–5 mm. broad, glabrous, the wings narrower than the body, the oil tubes solitary in the intervals, 2 on the commissure.

TYPE: *Lewis,* "on the waters of Columbia River" (probably on the main Kooskooskee River, vicinity of Cotter's or Potlatch Creek, below mouth of the North Fork), Idaho.

DISTRIBUTION: Western Montana and Wyoming to western Washington, southwestern Oregon, and northeastern California.

TYPICAL SPECIMENS: IDAHO: Josephus Lakes, Custer Co., *Macbride & Payson 3587* (M). WASHINGTON: Pullman, Whitman Co., *Elmer 846* (M). OREGON: near Prairie City, Grant Co., *Henderson 5187* (M).

Cogswellia triternata (Pursh) Coult. & Rose forma **lancifolia** St. John, Fl. S.E. Wash. & Adj. Ida. 293. 1937, has been published, but no specimens have been seen. According to description, it differs from *Lomatium triternatum* in its linear-lanceolate leaves 1 cm. or more in width.

58a. Lomatium triternatum (Pursh) Coult. & Rose var. **anomalum** (Jones) Mathias, comb. nov.

Lomatium anomalum Jones, ex Coult. & Rose, Contr. U. S. Nat. Herb. 7: 237. 1900.

L. giganteum Coult. & Rose, Contr. U. S. Nat. Herb. 7: 240. 1900.

? *Cogswellia anomala* Jones, Contr. Western Bot. 12: 32. 1908.

? *C. gigantea* (Coult. & Rose) Jones, Contr. Western Bot. 12: 32. 1908.

? *Lomatium nudicaule* (Pursh) Coult. & Rose var. *puberulum* Jepson, Madroño 1: 159. 1924.

? *Peucedanum nudicaule* Nutt. var. *puberulum* Gray, ex Jepson, Madroño 1: 159. 1924, nom. nud. in synon.

Plants caulescent; leaflets ovate-lanceolate to narrowly obovate, 15–65 mm. long, 3–8 mm. broad, acute, entire or the uppermost rarely 3-toothed to deeply lobed; umbels 10–22-rayed, the fruiting rays 1.5–8 cm. long, puberulent to glabrate; fruiting pedicels 2–8 mm. long; fruit 13–22 mm. long, 8–16 mm. broad, glabrous (ovaries and young fruit glabrous).

TYPE: *Jones*, rocky gumbo soil, slopes of Indian Valley, Washington Co., Idaho, 1200 meters, 15 July 1899 (Po).

DISTRIBUTION: Northwestern to southwestern Idaho (west to Oregon and California?).

TYPICAL SPECIMENS: IDAHO: Lewiston, Nez Perce Co., *Heller & Heller 3132* (M, NY, UC); forks of St. Mary's River, Coeur d'Alene Mts., *Leiberg 1128* (M, Po, UC); hills near Boise, *Mulford* (NY); Upper Ferry, Clearwater River above Lewiston, *Sandberg, MacDougal & Heller 28* (NY).

Lomatium giganteum Coult. & Rose and *L. nudicaule* var. *puberulum* Jepson are identical. The *Bolander* specimen (UC type coll. of *L. nudicaule* var. *puberulum)*, though immature, is a good match for the type of *L. anomalum* Jones, so these plants have been questionably referred to var. *anomalum* even though they are known only from northwestern California, and typical *L. anomalum* has so far been collected only in western Idaho. Further collections in the intervening area may show that the distribution is continuous in which case there will be no question as to identity.

58b. Lomatium triternatum (Pursh) Coult. & Rose var. **macrocarpum** (Coult. & Rose) Mathias, comb. nov.

Peucedanum triternatum (Pursh) Nutt. var. *macrocarpum* Coult & Rose. Rev. N. Am. Umbell. 70. 1888.

P. triternatum (Pursh) Nutt. var. *robustius* Coult. & Rose, Contr. U. S. Nat. Herb. **3**: 228. 1895.

Lomatium robustius Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 228. 1900.

Cogswellia triternata (Pursh) Jones var. *robustior* (Coult. & Rose) Jones, Contr. Western Bot. **12**: 32. 1908.

C. robustior Coult. & Rose, Contr. U. S. Nat. Herb. **12**: 451. 1909.

Leaves 12–22 cm. long, ternate or quinate, then biternate to bipinnate, the leaflets linear, sometimes ovate-lanceolate as in var. *anomala,* 1.5–14.5 cm. long, 1–11 mm. broad, entire; umbels 5–18-rayed, the fruiting rays unequal, 0.6–10.5 cm. long; fruiting pedicels 2.5–9 mm. long, the ovaries and young fruit puberulent, the mature fruit glabrous or rarely sparsely puberulent, oblong, 8–20 mm. long, 4–6 mm. broad.

TYPE: *Suksdorf 502,* low grounds, W. Klickitat Co., Washington, May–July 1883 (US).

DISTRIBUTION: Alberta to British Columbia, south to northern California and northwestern Nevada.

TYPICAL SPECIMENS: IDAHO: Big Willow, Canyon Co., *Macbride 107* (M, NY, UC). WASHINGTON: near Peshastin, *Sandberg & Leiberg 596* (M, NY, UC). OREGON: Maurey's Mts., *Cusick 2700* (M, NY, UC).

58c. Lomatium triternatum (Pursh) Coult. & Rose var. **brevifolium** (Coult. & Rose) Mathias, comb. nov.

Peucedanum triternatum (Pursh) Nutt. var. *brevifolium* Coult. & Rose, Rev. N. Am. Umbell. 70. 1888.

Lomatium brevifolium Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 232. 1900.

Cogswellia brevifolia (Coult. & Rose) Jones, Contr. Western Bot. **12**: 32. 1908.

Plants caulescent, 1.5–3.5 dm. tall, densely soft-puberulent; leaves quinately decompound, the final divisions pinnate, the leaflets remote, linear, 3–22 mm. long, 1–3 mm. broad; umbels 9–11-rayed; fruiting pedicels 1–4 mm. long; fruit linear-oblong, 6–8 mm. long, about 2 mm. broad, densely puberulent.

TYPE: *Howell 379,* Klickitat Co., Washington, 1881.

DISTRIBUTION: Klickitat Co., Washington and adjacent Oregon.

SPECIMENS EXAMINED: WASHINGTON: *Wilkes Exp. 1053* (NY); Klickitat Hills, *Howell 1368* (M, NY, Th, UC); opp. The Dalles, Klickitat Co., *Thompson 11545* (Th); near Maryhill, Klickitat Co., *Thompson 8176* (M, Th). OREGON: near The Dalles, *Mathias 779* (M); *Howell & Howell* (NY); Dalles, *Kellogg 183* (UC).

58d. Lomatium triternatum (Pursh) Coult. & Rose var. **alatum** (Coult. & Rose) Mathias, comb. nov.

Peucedanum triternatum (Pursh) Nutt. var. *alatum* Coult. & Rose, Rev. N. Am. Umbell. 70. 1888.
Lomatium alatum Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 228. 1900.
Cogswellia triternata (Pursh) Jones var. *alata* (Coult. & Rose) Jones, Contr. Western Bot. **12**: 32. 1908.
C. alata Coult. & Rose, Contr. U. S. Nat. Herb. **12**: 448. 1909.

Involucels few or absent; ovaries and young fruit pubescent, the wings half as broad to about equalling the body.

TYPE: *M. K. Curran*, "Folsom," California.
DISTRIBUTION: Northeastern California and adjacent Oregon.
SPECIMENS EXAMINED: OREGON: Lakeview, *Peck 15470* (Th).

A doubtful variety poorly distinguished from variety *macrocarpum* since the wing character may be a chance variation. The locality for the type collection is probably an error.

59. Lomatium Cusickii (Wats.) Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 226. 1900.

Peucedanum Cusickii Wats. Proc. Am. Acad. **21**: 453. 1886.
Cogswellia Cusickii (Wats.) Jones, Contr. Western Bot. **12**: 32. 1908.
C. brecciarum Jones, Contr. Western Bot. **12**: 32, 37. 1908.
C. altensis Jones, Bull. Univ. Mont. Biol. Ser. **15**: 41. 1910.
Cynomarathrum brecciarum (Jones) Rydb. Fl. Rocky Mts. 630, 1064. 1917.

Plants caulescent, 1–2.2 dm. tall, caespitose, from long slender fusing tap-roots; leaves obovate to transversely ovate, the blades 3.5–12 cm. long, glabrous to slightly scaberulent, ternately compound, the leaflets few, filiform to linear, 6–75 mm. long, 0.5–2 mm. broad, apiculate, the petioles 1–9 cm. long, more or less sheathing, purplish; peduncles exceeding the leaves, glabrous; umbels 5–12-rayed, the rays unequal, 1–3.5 cm. long; involucel bracts filiform to linear-acuminate, scarious-margined, about equalling the white or purplish flowers; umbellets about 10-flowered, the fruiting pedicels 2–6 mm. long; fruit oblong, 11–13 mm. long, 4–6 mm. broad, the wings about equalling the body, the oil tubes 1–3 in the intervals, 5 on the commissure.

TYPE: *Cusick*, "on the highest summits of the Eagle Creek Mountains, Union County, Oregon," September 1885, in fruit.

DISTRIBUTION: Mountains of western Montana to eastern Oregon, 6000 to 9300 feet.

SPECIMENS EXAMINED: MONTANA: Mt. Haggin near Anaconda, Ryan's Lake, Deer Lodge Valley, *Jones* (Po); Alta, *Jones* (Po type of *C. altensis).* IDAHO: Seven Devils Mts., Washington Co., *Jones* (Po), *Cusick 2228* (M). OREGON: *Cusick 3335* (M, NY, Po, UC); south slope of Wallowa Mts., *Cusick 2441* (M, Po, NY); Powder River Mts., *Piper 2333* (M, NY, Po), *Cusick* (UC); *Cusick 1280* (Po, UC).

The type of *Cogswellia brecciarum* Jones is a collection by Jones from Mt. Haggin, Montana, 3 August 1905. No material has been found collected by Jones at that locality on that date; however, collections of July 20, 1905, at 8000 feet on Mt. Haggin (Po 78273, 78277) match the description of *C. brecciarum* even to the immature fruit. These specimens are certainly true *L. Cusickii* and on the basis of the description of *C. brecciarum* and the collections of Jones on Mt. Haggin cited above there seems to be little question that *C. brecciarum* is conspecific with *L. Cusickii.*

60. Lomatium laevigatum (Nutt.) Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 225. 1900.

Peucedanum laevigatum Nutt. ex Torr. & Gray, Fl. N. Am. **1**: 627. 1840.
Cogswellia laevigata (Nutt.) Jones, Contr. Western Bot. **12**: 32. 1908.

Plants caulescent, 2.5–3.7 dm. tall, glabrous, tufted at the base; leaves ovate, the blades 7–12 cm. long, ternate, then 2–3-pinnate, the leaflets distinct, linear, 5–35 mm. long, 1–3 mm. broad, acute, minutely apiculate, the petioles 0.5–1.5 dm. long, sheathing below; peduncles exceeding the leaves; umbels 9–20-rayed, the rays unequal, 7–45 mm. long, ascending; involucel bracts usually absent; umbellets 10–30-flowered, the flowers yellow, the fruiting pedicels 4–10 mm. long; fruit oblong, 6–10 mm. long, 4–6 mm. broad, the wings slightly narrower than to equalling the body, the oil tubes solitary in the intervals, 2 on the commissure.

TYPE: *Nuttall,* Blue Mts., Oregon (Ph).

DISTRIBUTION: Columbia River Valley, Washington and Oregon.

SPECIMENS EXAMINED: WASHINGTON: near Columbus, Klickitat Co., *Suksdorf 863* (M, UC); along Beverly Creek, Wenatchee Mts., Kittitas Co., *Thompson 6388* (M, Th). OREGON: bluffs of the Columbia at Grants, *Howell 1505* (M, UC); bluffs of Columbia River, Summit, *Henderson 393* (UC).

61. Lomatium Suksdorfii (Wats.) Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 239. 1900, in part, and as to name-bringing synonym.

Peucedanum Suksdorfii Wats. Proc. Am. Acad. **20**: 369. 1885.
Cogswellia Suksdorfii (Wats.) Jones, Contr. Western Bot. **12**: 32. 1908.

Plants caulescent, glabrous, 9–21 dm. tall; stems from a cluster of old leaf sheaths; leaves obovate, the blades about 20 cm. long, quinate, biquinate, or biternate, then 1–2-pinnate, the leaflets remote, linear, acute, 10–30 mm. long, 1–4 mm. broad, the petioles 14–15 cm. long, sheathing below, cauline leaves similar or with an entirely sheathing petiole; peduncles exceeding the leaves; umbels 13–25-rayed, the rays unequal, 3–11 cm. long, spreading; involucel bracts several, linear, acuminate, subscarious, about equalling the yellow flowers, deciduous in the mature plant; umbellets many-flowered, the fruiting pedicels 6–17 mm. long; fruit linear-oblong, 15–32 mm. long, 7–8 mm. broad, the wings narrower than the body, the oil tubes 1, rarely 3–4, in the intervals, 2 on the commissure.

TYPE: *Suksdorf*, on dry rocky mountain sides, W. Klickitat Co., Washington, June and July 1883 (M, NY, UC type coll.).
DISTRIBUTION: Klickitat Co., Washington.
SPECIMENS EXAMINED: WASHINGTON (Klickitat Co.): Bingen, *Suksdorf* (NY); *Suksdorf* (M, NY); *Suksdorf 503* (NY).

61a. Lomatium Suksdorfii (Wats.) Coult. & Rose var. **Thompsonii** Mathias, var. nov.

Planta foliis caulibusque pubescentibus, foliis biternatis, rare quinatis, deinde bipinnatis, foliolis 8–16 mm. longis, 1–2 mm. latis; bracteis involucelli filiformibus, floribus longioribus; ovariis et fructibus immaturis puberulis, fructibus maturis glabratis; fructibus 24–28 mm. longis, 8–10 mm. latis.

Leaves biternate, rarely quinate, then bipinnate, the leaflets short, 8–16 mm. long, 1–2 mm. broad; foliage and stems finely and sparingly pubescent; involucel bracts filiform, longer than the flowers; ovaries and young fruit puberulent, the mature fruit glabrate; fruit 24–28 mm. long, 8–10 mm. broad.

TYPE: *Sandberg & Leiberg 489*, Peshastin, Okanogan Co., 340 m., 19 July 1893 (M 137759 TYPE, NY, UC).
DISTRIBUTION: Chelan and Okanogan counties, Washington.

SPECIMENS EXAMINED: WASHINGTON: *Vasey 300* (NY); open slopes above Ingalls Creek, Chelan Co., *Thompson 9000* (M, NY, UC); rocky bank 2 miles west of Dryden, Chelan Co., *Thompson 5989* (M, Th).

This variety is named in honor of Mr. J. W. Thompson, of Seattle, Washington, whose collections in that state have greatly aided in the study of this genus.

62. Lomatium Brandegei (Coult. & Rose) Macbr. Contr. Gray Herb. n.s. **56**: 35. 1918.

Peucedanum Brandegei Coult. & Rose, Bot. Gaz. **13**: 210. 1888; Rev. N. Am. Umbell. 72. 1888.

Cynomarathrum Brandegei Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 246. 1900.

Cogswellia Brandegei (Coult. & Rose) Jones, Contr. Western Bot. **12**: 32. 1908.

Plants caulescent, 1.5–6 dm. tall, from an elongated tap-root; stems glabrous, alternately few-branched; leaves mostly basal from a cluster of dried sheaths, obovate, the blades 8–20 cm. long, ternate, then 2–3-pinnate, the leaflets remote, linear-lanceolate to oblanceolate, 10–40 mm. long, 1.5–8 mm. broad, acute, mucronate, the margins glabrous to granulate-roughened, the petioles 1.5–14 cm. long, shortly sheathing below; peduncles exceeding the leaves; umbels 10–21-rayed, the fruiting rays spreading, sometimes reflexed, subequal, 4–43 mm. long; involucel bracts several, linear, acute, subscarious, longer than the pedicels; umbellets 10–25-flowered, the fertile flowers 1–5, the flowers yellow, the fruiting pedicels 0.5–5 mm. long; fruit linear-oblong, 9–12 mm. long, about 4 mm. broad, mostly reflexed, the wings narrower than the body, the oil tubes 1–4 (usually 3) in the intervals, 6–7 on the commissure.

TYPE: *Brandegee 799*, Walla Walla region, Washington, May 1883.

DISTRIBUTION: Rocky slopes, 3000 to 6500 feet, Chelan, Okanogan and Kittitas counties, Washington.

TYPICAL SPECIMENS: WASHINGTON: dry open slopes below Stuart Pass, Chelan Co., *Thompson 7728* (M, NY, UC, US); yellow pine slopes of Tronson Ridge, Chelan Co., *Thompson 9310* (M, NY, Po, UC).

63. Lomatium nudicaule (Pursh) Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 238. 1900.

Smyrnium nudicaule Pursh, Fl. **1**: 196. 1814.

Ferula nudicaulis Nutt. Gen. **1**: 182. 1818.

Pastinaca nudicaulis (Pursh) Spreng. ex Linn. Syst. Veg. ed. Roem. & Schult. **6**: 587. 1820.

Ferula Nuttallii DC. Prodr. 4: 174. 1830.
Seseli leiocarpum Hook. Fl. Bor.-Am. 1: 263. 1834.
Peucedanum latifolium Nutt. ex Torr. & Gray, Fl. N. Am. 1: 625. 1840, not DC. (1830).
P. leiocarpum Nutt. ex Torr. & Gray, Fl. N. Am. 1: 626. 1840.
P. leiocarpum Nutt. var. *campestre* Nutt. ex Torr. & Gray, Fl. N. Am. 1: 626. 1840.
P. nudicaule Nutt. ex Torr. & Gray, Fl. N. Am. 1: 627. 1840, not of later authors.
P. Nuttallii Wats. Bot. King Exp. 128. 1871, not *Seseli Nuttallii* Gray (1870).
P. triternatum acc. to Gray, Proc. Am. Acad. 8: 385. 1873, not Nutt. (1840).
P. robustum Jepson, Erythea 1: 9. 1893.
Lomatium platyphyllum Coult. & Rose, Contr. U. S. Nat. Herb. 7: 238. 1900.
Cogswellia nudicaulis (Pursh) Jones, Contr. Western Bot. 12: 31. 1908.
C. latifolia (Nutt.) Jones, Contr. Western Bot. 12: 31. 1908.
C. platyphylla Coult. & Rose, Contr. U. S. Nat. Herb. 12: 450. 1909.

Plants acaulescent, rarely with 1 stem leaf, 2.5–7 dm. tall, glabrous, from a long thickened tap-root; leaves broadly ovate, the blades 9–18 cm. long, 1–2-ternate, then pinnate, the leaflets distinct, lanceolate to broadly ovate, entire or toothed and lobed at the apex, 1.5–9 cm. long, 0.5–4 cm. broad, the petioles 4–25 cm. long, sheathing to above the middle; peduncles exceeding the leaves, swollen at the apex; umbels 10–20-rayed, the rays 1–20 cm. long, ascending, usually all fertile, somewhat swollen at the apex; involucel absent; umbellets many-flowered, the flowers yellow, mostly fertile, the fruiting pedicels 3–15 mm. long; fruit oblong, 10–14 mm. long, 3–5 mm. broad, the wings narrower than the body, the oil tubes solitary in the dorsal intervals, 1–several in the lateral intervals, 4–7 on the commissure.

The Indians eat the tops of the plant and boil it in their soups.

Type: *Lewis*, on the Columbia River (Rock Fort Camp, at The Dalles), Washington (Ph).

Distribution: Alberta and British Columbia to central California, east to Idaho and western Utah.

Typical specimens: washington: Wenatchee Mts., Kittitas Co., *Elmer 475* (NY, Po, US); Peshastin, Okanogan Co., *Sandberg & Leiberg 487* (NY, UC, US); Leavenworth, Chelan Co., *Thompson 8455* (M, NY, Po, UC). california: Genesee Valley, Plumas Co., *Hall & Babcock 4441* (M, UC, US); near Marston Station, Plumas Co., *Heller 10834* (NY, UC, US); Yreka, Siskiyou Co., *Butler 1363* (Po, UC, US).

The Nuttall type of *Peucedanum leiocarpum* has pedicels mostly longer than the fruit, oil tubes solitary in the intervals, and linear-lanceolate leaflets. The Nuttall type of *P. latifolium* has pedicels shorter than the fruit, oil tubes several in the intervals, and ovate to suborbicular leaflets. However, in the numerous specimens examined the character of short pedicels is combined with linear leaflets, and the oil-tube number is variable. Because these various forms inhabit the same range it is possible that they represent a hybrid mixture of two formerly distinct species and the hybrid generations have become dominant in the region. In every case, however, the inflated peduncle is a constant and easily discernible character setting this species off from all others in the genus.

EXCLUDED SPECIES

Cogswellia duchesnensis Jones, acc. to Gray Card Index, in err. = **Cymopterus duchesnensis** Jones, Contr. Western Bot. **13**: 12. 1910.

Cogswellia lapidosa (Jones) Rydb. Fl. Rocky Mts. 627. 1917 = **Cymopterus longipes** Wats. Bot. King Exp. 124. 1871.

Cogswellia Lemmoni (Coult. & Rose) Jones, Contr. Western Bot. **12**: 33. 1908 = **Pseudocymopterus montanus** (Gray) Coult. & Rose, Rev. N. Am. Umbell. 74. 1888.

Cynomarathrum Macbridei A. Nels. Bot. Gaz. **54**: 142. 1912 = **Pseudocymopterus humboldtensis** (Jones) Mathias, Ann. Mo. Bot. Gard. **17**: 325. 1930, ex char.

Lomatium lapidosum (Jones) Garrett, Spring Fl. Wasatch Reg. 110. 1927 = **Cymopterus longipes** Wats. Bot. King Exp. 124. 1871.

Lomatium Lemmoni Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 213. 1900 = **Pseudocymopterus montanus** (Gray) Coult. & Rose, Rev. N. Am. Umbell. 74. 1888.

Peucedanum lapidosum Jones, Zoe **2**: 246. 1891 = **Cymopterus longipes** Wats. Bot. King Exp. 124. 1871.

Peucedanum Lemmoni Coult. & Rose, Bot. Gaz. **14**: 277. 1889 = **Pseudocymopterus montanus** (Gray) Coult. & Rose, Rev. N. Am. Umbell. 74. 1888.

Peucedanum ludovicianum Raf. ex Torr. & Gray, Fl. N. Am. **1**: 629. 1840, nom. nud. = **Oxypolis** sp.

Peucedanum Newberryi Wats. Am. Nat. **7**: 301. 1873 = **Cymopterus Newberryi** (Wats.) Jones, Zoe **4**: 47. 1893.

Peucedanum rigidius (L.) Baill. Hist. **7**: 187. 1880 = **Oxypolis rigidior** (L.) Raf. Neogenyt. **2**: 1825; Sér. Bull. Bot. **1**: 218. 1830.

Peucedanum salmoniflorum Coult. & Rose, ex Holzinger, Contr. U. S. Nat. Herb. **3**: 228. 1895 = **Leptotaenia salmoniflora** Coult. & Rose, Contr. U. S. Nat. Herb. **7**: 201. 1900.

Peucedanum ternatum Nutt. Gen. **1**: 182. 1818 = **Oxypolis ternata** (Nutt.) Heller, Cat. N. Am. Pl. 5. 1898.

INDEX TO SPECIES AND GENERA

Accepted names are in Roman type; synonyms are in *italics;* new species and new combinations are in **bold-face** type; the page number on which the description appears is in **bold-face** type.

STUDIES IN THEACEAE. III

Eurya subgenera Euryodes and Penteurya

CLARENCE E. KOBUSKI

Assistant Curator of the Herbarium, Arnold Arboretum of Harvard University

The genus *Eurya* was first described by Thunberg[1] in 1783 with *E. japonica,* the type-species. By 1854, over forty species had been added to this genus by various workers. During this year, A. Gray[2] described three new species from the Pacific Islands and established a subgenus Euryodes for two of his species, *E. Pickeringii* and *E. Richii.* Pentandrous staminate flowers formed the basis for this segregation.

In 1893, Szyszylowicz[3] recognized three sections: Cleyera, Freziera and Proteurya. In his study he had enlarged the scope of the genus by including two other genera, *Cleyera* Thunberg and *Freziera* Swartz. Also he instituted the new section Proteurya under which he placed the subgenus Euryodes A. Gray.

Two years later (1895), Vesque,[4] overlooking Szyszylowicz' treatment, proposed four sections: Eueurya, Euryodes, Gynandra and Meristotheca. The last two mentioned were designated as new. Proteurya was included under Eueurya. To my knowledge this was the first time that the name Eueurya had been used as a divisional name for this genus. Vesque's key and sections were based on anatomical characters and proved impracticable; hence they have been little used.

In 1896, Urban[5] established a new genus, *Ternstroemiopsis* with *Eurya sandwicensis* A. Gray as the type. At the same

[1] Thunberg, Nov. Gen. Pl. 68 (1783).

[2] A. Gray, Bot. U. S. Expl. Exped. 1838–1842, 1: 211(1854).

[3] Szyszylowicz in Engler & Prantl, Nat. Pflanzenfam. III. 6: 189(1893).

[4] Vesque in Bull. Soc. Bot. France, 42: 151(1895).

[5] Urban in Ber. Deutsch. Bot. Gesell. 14: 49(1896).

Issued December 27, 1937.

time he treated *Freziera, Cleyera* and *Eurya* as separate genera.

The following year (1897), Engler[6] studied the genus *Eurya* and subdivided it into the following subgeneric heads: Cleyera, Freziera, Proteurya and Ternstroemiopsis. Again A. Gray's subgenus was included in Proteurya.

In 1935, the present author,[7] in the first of a series of studies in the Theaceae, presented a synopsis of the subgenus Ternstroemiopsis and recognized one other subgenus, Proteurya. *Cleyera*[8] and *Freziera* were excluded as distinct genera. Since that time, after studying the remaining species of *Eurya,* I feel that three subgenera should be recognized, namely, Ternstroemiopsis, Euryodes (Proteurya) and a new subgenus Penteurya. This study brought out the fact that the divisional name Euryodes (1854) antedates the name Proteurya (1893). Since the time of Vesque most workers have felt that Gray's basis of separation, that of pentandrous staminate flowers, was insufficient to separate it from Proteurya. Gray, having only staminate specimens, could not know that the pistillate specimens would agree with the other then-known species of *Eurya* by having three-parted styles and stigmas. In merging these two subdivisions under the same heading the name Euryodes, because of its priority, must be used since the International Rules stipulate that the first divisional name established must be accepted.

In working over the New Guinean material I was surprised to find species having both pentandrous stamens and five-parted styles and stigmas. As far as I know, with the exception of two, all New Guinean species belong to this new subgenus described below.

The fact that the genus is dioecious makes the presentation of a natural key very difficult. Instead, an artificial key has been prepared. Except in a very few instances, the species are confined to distinct geographical regions. Therefore, it has

[6] Engler in Engler & Prantl, Nat. Pflanzenfam. Nachtr. 1: 246 (1897).
[7] Kobuski in Jour. Arnold Arb. 16: 347 (1935).
[8] Kobuski in Jour. Arnold Arb. 18: 118 (1937).

been considered advisable to separate the genus into five geographical groups and prepare an individual key for each group.

To make this study possible borrowed material, photographs and fragments of types were obtained from many European and Oriental herbaria as well as American institutions. In a few instances reference is made to some of these institutions by abbreviations accompanying the citation of critical specimens. These are as follows: AA = Arnold Arboretum, BM = British Museum, FM = Field Museum, G = Gray Herbarium, NY = New York, SY = Sun Yatsen, V = Vienna. Professor Alfred Rehder, Curator of the Herbarium of the Arnold Arboretum, while visiting European herbaria diligently searched for many obscure types and specimens, photographed them and procured fragments when possible. His carefully prepared notes concerning the types have been most helpful. Dr. E. D. Merrill, Director of the Arnold Arboretum, has also displayed a keen interest and has offered constructive criticism in the development of this study. To all assisting in this work, I am deeply grateful.

This paper is affectionately dedicated to Dr. Jesse More Greenman, for years my professor, advisor and friend.

KEY TO THE SUBGENERA

Folia spiraliter disposita; petala carnosa; antherae filamentis duplo longiores ....1. TERNSTROEMIOPSIS[1]

Folia plus minusve disticha; petala plus minusve membranacea; antherae filamentis plerumque breviores.

Stylus tri-partitus, interdum quadri-partitus; stamina 5, 10 vel 15...2. EURYODES

Stylus quinque-partitus; stamina 5................3. PENTEURYA, subgen. nov.

KEY TO THE SPECIES OF CHINA, INDO-CHINA, INDIA AND CEYLON

A. Terminal leaf-buds and young branchlets glabrous.

B. Leaves sessile; base auriculate with lobes clasping the stem.......... ....1. *E. amplexifolia*

BB. Leaves petiolate; base entire.

C. Young branchlets terete.

D. Leaves entire or nearly so.*

E. Leaves tapering to an acuminate apex.............2. *E. Macartneyi*

* *E. Macartneyi* occasionally with some leaf serration.

[1] Kobuski in Jour. Arnold Arb. 16: 347(1935).

EE. Leaves bluntly obtuse at the apex........12a. *E. cuneata* var. *glabra*
DD. Leaves sharply serrate............2a. *E. Macartneyi* var. *hainanensis*
CC. Young branchlets angled.
F. Branchlets four-angled.
G. Leaves up to 25 cm. long, 6 cm. wide; veins, 20 or more pair, deeply impressed on upper surface, highly raised (even to cross veins) on lower surface; style 5–6 mm. long.......3. *E. polyneura*
GG. Leaves up to 10–11 cm. long, ca. 3 cm. wide; veins raised on upper surface, inconspicuous; style short (1 mm. long)..........
....4. *E. tetragonoclada*
FF. Branchlets two-angled.
H. Leaves narrow, usually 0.5–0.8 cm. wide, occasionally up to 1 cm. wide; fruit oblong............................5. *E. stenophylla*
HH. Leaves usually much wider (occasionally only 1.7 cm. wide in *E. Handeliana*); fruit globose.
I. Veins on upper surface deeply impressed, as if etched........
....6. *E. Handeliana*
II. Veins on upper surface raised or inconspicuous, never impressed.
J. Leaves tapering at both ends, oblong..............7. *E. nitida*
JJ. Leaves rounded at base, obtusely acuminate, wider because of rounded base....................7a. *E. nitida* var. *aurescens*
AA. Terminal leaf-buds and young branchlets pubescent.
K. Ovary and fruit glabrous.
L. Leaf-base oblique or lobed.
M. Leaves 8–10 cm. long, membranaceous, long-attenuate at apex, margins flat, not revolute..........................8. *E. obliquifolia*
MM. Leaves 4–6 cm. long, coriaceous, apex blunt occasionally, shortly acuminate, margins revolute.....................9. *E. glandulosa*
LL. Leaf-base cuneate, occasionally somewhat rounded, never lobed or oblique.
N. Leaves rounded at apex, emarginate, never acuminate..........
....10. *E. emarginata*
NN. Leaves acuminate at apex.
O. Margins entire, occasionally slightly undulate, never sharply serrate...11. *E. cuneata*
OO. Margins sharply serrate, never entire.
P. Leaves (majority) small, less than 4 cm. long.
Q. Leaves evenly elliptic-acuminate; veins deeply impressed on upper surface..............................12. *E. Fangii*
QQ. Leaves obovate, quite obtuse at apex, sometimes nearly rounded; veins upraised or nearly insignificant on upper surface................................13. *E. chinensis*
PP. Leaves considerably longer, 6–12 cm. long.
R. Leaves thick, coriaceous; margins revolute......14. *E. ceylanica*
RR. Leaves membranaceous or nearly membranaceous;* margins not revolute.

* In case of *E. symplocina*, the older leaves are occasionally quite coriaceous.

S. Calyx pubescent; terminal leaf-bud and young branchlets pilose.
T. Leaves narrowly lance-acuminate, usually three times as long as wide; veins not especially conspicuous on upper surface........................15. *E. acuminata*
TT. Leaves wide-lanceolate, up to 4 cm. wide, veins conspicuously depressed on upper surface.......16. *E. cerasifolia*
SS. Calyx glabrous; terminal leaf-bud and young branchlets minutely puberulent, sometimes appearing glabrous.... ....17. *E. Loquaiana*
KK. Ovary and fruit pubescent.
U. Leaves auriculate at base, clasping stem................18. *E. disticha*
UU. Leaves cuneate or rounded at base, not auriculate or clasping.
V. Calyx glabrous.
W. Fruit becoming glabrescent at maturity with only occasional hairs present; leaves delicately tapering at both ends; terminal bud finely puberulent, at times appearing almost glabrous...................................19. *E. trichocarpa*
WW. Fruit pubescent at maturity, leaves although tapering somewhat, nearly rounded at base; terminal bud pilose.......... ....21a. *E. distichophylla* var. *Henryi*
VV. Calyx pubescent.
X. Leaves huge, 10–14 cm. long, 5 cm. wide............20. *E. velutina*
XX. Leaves up to 10 cm. long, narrow-lanceolate, seldom over 2 cm. wide.
Y. Calyx obtuse, with short pilose hairs; styles trifid............ ....21. *E. distichophylla*
YY. Calyx acuminate, densely covered with long yellow hairs; styles usually 4-fid..............................22. *E. ciliata*

KEY TO THE SPECIES OF JAPAN, KOREA, FORMOSA AND LIU KIU ISLANDS

A. Pubescent ovary and fruit.
B. Leaves narrow lanceolate, up to 14 cm. long; strigillose-pubescent on stems as well as fruit....................23. *E. strigillosa* (Formosa)
BB. Leaves ovate-elliptic, up to 7 cm. long; stem glabrous or nearly so, not strigillose..........................24. *E. gnaphalocarpa* (Formosa)
AA. Glabrous ovary and fruit.
C. Largest leaves less than 4 cm. long, usually 2–3 cm. or less.
D. Leaves membranaceous, 2–3 cm. rarely 4 cm. long................ ....25. *E. leptophylla* (Formosa)
DD. Leaves coriaceous, minute, usually less than 1 cm. long, occasionally 2 cm. long.
E. Leaves about as broad as long, less than 0.5 cm. either way, seemingly entire, deeply emarginate, obcordate.................... ....11a. *E. emarginata* var. *microphylla* (Japan)

EE. Leaves longer than broad, although small, leaves always found up to 1.5–2.0 cm. long, serrate, never obcordate in shape.

F. Leaves acute at apex, elliptic........26. *E. crenatifolia* (Formosa)

FF. Leaves obtuse at apex, obovate............................ ....31a. *E. japonica* var. *microphylla* (Japan)

CC. Largest leaves up to 11–12 cm. long, all considerably longer than 4 cm.

G. Entirely glabrous even to terminal bud.

H. Branches winged, stem growth zigzag from node to node.

I. Twenty stamens, filaments twice as long as anthers............ ....27. *E. yaeyamensis* (Liu Kiu)

II. Ten stamens, anthers twice as long as filaments................ ....28. *E. zigzag* (Liu Kiu)

HH. Branches perhaps slightly winged, zigzag growth absent.

J. Leaves sharply toothed, evenly elliptic..29. *E. glaberrima* (Formosa)

JJ. Leaves nearly entire or undulate-serrate, never sharply toothed.

K. Leaves nearly entire, very slight serration.................. ....30. *E. Hayatai* (Formosa)

KK. Leaves always undulate-serrate, usually more noticeable at apex..............................31. *E. japonica* (Japan)

GG. Pubescence found on stem as well as terminal buds.

L. Leaves acuminate, attenuate at apex.

M. Leaves 3.5 cm. wide, robust........32. *E. rengechiensis* (Formosa)

MM. Leaves less than 2 cm. wide at broadest part......15. *E. acuminata*

LL. Leaves obtuse at apex.

N. Leaves heavy-coriaceous, perfectly obovate, rounded at apex, never acuminate, distinctly emarginate, slightly serrate.......... ....10. *E. emarginata*

NN. Leaves coriaceous, sometimes obovate, always acuminate, usually not emarginate, distinctly serrate................13. *E. chinensis*

KEY TO THE SPECIES OF THE PHILIPPINE ISLANDS

A. Leaves auriculate (heart-shaped) at base, sessile, clasping the stem...... ....33. *E. amplexicaulis*

AA. Leaves cuneate at base, petioled.

B. Terminal buds pubescent.

C. Pubescent ovary and young fruit.

D. Leaves ovate-elliptic, acute apex not attenuate; fruit pubescent at maturity................................24. *E. gnaphalocarpa*

DD. Leaves long attenuate; fruit glabrescent at maturity..19. *E. trichocarpa*

CC. Glabrous ovary and fruit.

E. Leaves very short-petiolate, nearly sessile; branches terete........ ....34. *E. buxifolia*

EE. Leaves petioled 2–3 mm. long; young branches angled.....35. *E. flava*

BB. Terminal buds glabrous.

F. Styles partially connate, 2–2.5 mm. long....................7. *E. nitida*

FF. Styles free to base, very short, 1 mm. or less..............36. *E. coriacea*

KEY TO THE SPECIES OF THE DUTCH EAST INDIES, SAMOA AND FIJI ISLANDS

A. Staminate flowers pentandrous.
  B. Entirely glabrous....................................37. *E. Pickeringii*
  BB. Pubescent terminal buds and young branchlets...............38. *E. Richii*
AA. Staminate flowers decandrous or polyandrous.
  C. Ovary and young fruit pubescent......................19. *E. trichocarpa*
  CC. Ovary and young fruit glabrous.
    D. Terminal buds and branchlets pubescent.
      E. Leaf serration rounded-undulate (Fiji)...............39. *E. vitiensis*
      EE. Leaf serration sharp (Dutch E. Indies).............15. *E. acuminata*
    DD. Terminal buds and branchlets glabrous.
      F. Young branchlets terete.............................40. *E. glabra*
      FF. Young branchlets angled.
        G. Flower buds and fruit conical in shape............41. *E. coneocarpa*
        GG. Flower buds and fruit globose, not conical.
          H. Persistent style 2–3 mm. long, connate nearly its whole length ....7. *E. nitida*
          HH. Persistent style hardly 1 mm. long, free nearly to base.
            I. Leaves obtuse at apex, bluntly acuminate.........42. *E. obovata*
            II. Leaves oblong-elliptic, tapering-acuminate, not obtuse at apex ....42a. *E. obovata* var. *sinaboengensis*

KEY TO THE SPECIES OF NEW GUINEA

A. Style and stigma three-parted. [Subgenus EURYODES.]
  B. Branches glabrous; leaves 10–15 cm. long, 4–5 cm. wide....43. *E. Roemeri*
  BB. Branches clothed with dense fulvous, appressed pilose pubescence; leaves 2–3 cm. long, 0.7–1.0 cm. wide...................44. *E. Greenmaniana*
AA. Style and stigma five-parted. [Subgenus PENTEURYA.]
  C. Leaves obtuse at apex, not acuminate.
    D. Leaves 3 cm. or less long.
      E. Branchlets sparingly pubescent; leaves cuneate or subrotund at base, not cordate..............................45. *E. Hellwigii*
      EE. Branchlets densely pilose or tomentose; leaves cordate..46. *E. albiflora*
    DD. Leaves approximately 6 cm. long...................47. *E. Merrilliana*
  CC. Leaves acuminate at apex.
    F. Leaves membranaceous, not coriaceous; pilose, at least when young.
      G. Leaves rounded at base.............................48. *E. tigang*
      GG. Leaves cuneate at base.
        H. Leaves 10–13 cm. long........................49. *E. meizophylla*
        HH. Leaves 4–5 cm. long............................50. *E. leptantha*
    FF. Leaves coriaceous; glabrous (except in case of *E. phyllopoda).*
      I. Leaves serrate at acuminate apex only..............51. *E. Rehderiana*
      II. Leaves serrate along complete margin.
        J. Terminal buds glabrous.........................52. *E. oxysepala*
        JJ. Terminal buds closely silky-strigose...............53. *E. phyllopoda*

Subgenus EURYODES

Eurya subgenus **Euryodes** A. Gray, Bot. U. S. Explor. Exped. 1838–1842, **1**: 211(1854).

Eurya section *Proteurya* Szyszylowicz in Engler & Prantl, Nat. Pflanzenfam. III. **6**: 190(1893).
Eurya section *Eueurya* Vesque in Bull. Soc. Bot. France, **42**: 151(1895).
Eurya subgenus *Proteurya* (Szyszylowicz) Engler in Engler & Prantl, Nat. Pflanzenfam. Nachtr. **1**: 247(1897).

1. **Eurya amplexifolia** Dunn in Kew Bull. Misc. Inform. Add. Ser. **10**: 44 (Fl. Kwangtung) (1912).—Melchior in Engler & Prantl, Nat. Pflanzenfam. ed. 2, **21**: 148(1925).

DISTRIBUTION: China (Kwangtung).

CHINA. KWANGTUNG: on slope along road, *N. K. Chun 42586*, Apr. 5–May 1, 1931; *F. A. McClure 415; J. L. Gressitt 1745; W. T. Tsang 21037, 21116, 21218, 21660.*

This species is characterized by its large (16 cm. × 5 cm.) amplexicaul leaves. The two auriculate basal lobes extend as much as 1.0–1.5 cm. beyond and often overlap the other side of the stem. The younger branchlets are two-winged, glabrous even to the terminal bud. The fruit is oblong-ovate (7 mm. × 4 mm.) with a short style (less than 1 mm.) which is connate most its length.

2. **Eurya Macartneyi** Champion in Proc. Linn. Soc. London, **2**: 99(1850).—Bentham in Hooker's Jour. Bot. Kew Misc. **2**: 307(1851).—Mueller in Walpers, Ann. Bot. Syst. **4**: 347(1857).—Seemann, Bot. Voy. Herald, 366, t. 74(1857).—Bentham, Fl. Hongkong. 28(1861).—Champion in Trans. Linn. Soc. London, **21**: 113(1873).—Hemsley in Jour. Linn. Soc. Bot. **23**: 77(1886).—Dunn & Tutcher in Kew Bull. Misc. Inform. Add. Ser. **10**: 43 (Fl. Kwangtung & Hongkong) (1912).—Melchior in Engler & Prantl, Nat. Pflanzenfam. ed. 2, **21**: 148(1925).

DISTRIBUTION: China (Kwangtung, Hainan, Kwangsi).

CHINA. KWANGTUNG: *Lord G. Macartney, s.n.* (type in BM; photo. and fragment, AA); *C. Ford s.n.; C. Wright s.n.; C. S. Sargent s.n.; C. Wilford s.n.; H. Fenzel 31; H. Green 1183; Y. Tsiang 1282; W. T. Tsang 16677, 20090; W. Y. Chun 5813, 5920, 5935, 7546; L. Gibbs 7428; S. K. Lau 2732, 24090, 24740, 24944; C. L.*

Tso 20174, 20325, 20904, 22686; Z. S. Chung 11097; L. Yiu 10603; D. H. King 9856; C. Wang & H. Y. Liang 31272, 31279; C. Wang 31643; N. K. Chun 40890, 41392, 41782, 41786, 41907, 42032, 42037; H. Y. Liang 60501, 61018, 61241, 61242; S. P. Kwok 80043, 80064.—HAINAN: *H. Y. Liang 63300, 63740, 63841.*—KWANGSI: *R. C. Ching 8008, 8242; W. T. Tsang 22737.*

In most species of *Eurya*, one finds winged branchlets accompanying strictly glabrous terminal buds. *Eurya Macartneyi* is one of the few exceptions to this group, having terete branchlets with glabrous terminal buds. The branchlets are sturdy, as are the leaves, petioles and flower buds. The large leaves have pronounced veining on the upper surface, revolute margins and slight serration if any. The fruit is globose while the attached style is approximately 1 mm. long and free its entire length.

2a. **Eurya Macartneyi** Champion var. **hainanensis**, var. nov.
A typo recedit foliis latioribus, acutius serratis, acuminatis.

DISTRIBUTION: China (Hainan).

CHINA. HAINAN: in forest, Mo San Ling, alt. 900 m., *N. K. Chun & C. L. Tso 44361* (type, AA), Nov. 24, 1932 (tree 6 m. with gray bark; leaves coriaceous, deep green, glabrous; fruit purple); *N. K. Chun & C. L. Tso 44300; F. C. How 72119, 72156, 72628, 73496, 73575; H. Y. Liang 64341, 64698, 64700; C. Wang 34610, 35094, 35537, 36022, 36091, 36247.*

This variety can be distinguished from the species by its wider, acuminate and sharply serrate leaves which, although coriaceous, are not as thick as those of the species.

3. **Eurya polyneura** Chun in Sunyatsenia, **2**: 55, pl. 16 (1934); in Hu & Chun, Icon Pl. Sin. **5**: 7, pl. 207 (1937).

DISTRIBUTION: China (Kwangtung).

CHINA. KWANGTUNG: side of ravine, Taimo Shan, Sunyi Terr., *S. P. Ko 51272* (isotype, AA), Nov. 4, 1931 (shrub 4 m. tall; leaves deep green above, pale green below); *C. Wang 31040, 37884, 38016, 31980.*

As the name signifies, the outstanding character of this species is the veining. The leaves are large, oblong-lanceolate, 15–25 cm. long, 4–6 cm. wide. The principal lateral veins, impressed on the upper surface, are strongly elevated on the lower surface. There are 25 or more to each side of the midrib and,

being joined nearly at right angles to the midrib, present a scalariform appearance. These veins anastomose near the margin. Besides this character, the branches are stout, angular and ridged; the fruit is oblong-ovoid, 11 mm. long, 5 mm. wide, glabrous. The persistent style is about 5 mm. long and connate for most its length. The ♂ flowers have not been seen.

4. **Eurya tetragonoclada** Merrill & Chun in Sunyatsenia, **1:** 71(1930).—Chun in Hu & Chun, Icon. Pl. Sin. **5:** 8, pl. 208(1937).

Distribution: China (Kwangtung).

China. kwangtung: in woods, Kow Fung, Lok Chong District, *C. L. Tso 20683* (isotype, AA), May 20, 1929; *H. Y. Liang 61265; S. P. Ko 51150.*

Because of its sharply 4-angled branchlets this species is immediately associated with *E. polyneura* which is distinctive for the same character. They can be easily separated by the style and leaf venation. This species has a comparatively short, stout style (1 mm.) while *E. polyneura* has a style of 5–6 mm. Also the leaf-veining in *E. tetragonoclada* is rather inconspicuous while in *E. polyneura* there are more than twenty pair. These, in turn, are sharply raised on the lower leaf-surface.

5. **Eurya stenophylla** Merrill in Philipp. Jour. Sci. **21:** 502(1922); in Univ. Calif. Publ. Bot. **13:** 136(1926).—Melchior in Engler & Prantl, Nat. Pflanzenfam. ed. 2, **21:** 148(1925).

Distribution: China (Kwangtung, Kwangsi), Indo-China, India (Burma).

China. kwangtung: Tung Sing, *K. K. Ts'oong 1940* (type, NY), June 28, 1918.—kwangsi: *W. T. Tsang 22373, 22668, 22757; R. C. Ching 6138, 7835, 8071; A. N. Steward & H. C. Cheo 977.*

Indo-China: *A. Petelot 1802, 3948.*

India: *F. K. Ward 9087.*

This is one of the strictly glabrous species, glabrous even to the terminal bud. As in the majority of these glabrous species, the branchlets are narrowly winged. The fruit is oblong-ovoid (7–8 mm. × 4.0 mm) rather than globose. The pedicel on the fruit is comparatively long as is the persistent style (up to 5 mm.). The leaves are narrow, sometimes only 0.5 cm. wide, while 4 cm. long.

6. **Eurya Handeliana**, spec. nov.

Eurya aurescens sensu Handel-Mazzetti, Symb. Sin. 7: 400 (1931), quoad descript. excl. syn.; non *Eurya japonica* Thunberg var. *aurescens* Rehder & Wilson.

Frutex glaber 1.0–2.5 m. altus, ramis verruculosis; foliis coriaceis oblongo-ellipticis vel obovatis 3.5–6.0 cm. longis et 1.0–2.2 cm. latis obtuse acuminatis emarginatis basi cuneatis supra viridibus subtus luteo-viridibus margine serratis revolutis, venis supra profunde impressis reticulatis, petiolo 2 mm. longo; floribus axillaribus singularibus vel binis; florum ♂ pedicellis 2 mm. longis, bracteis 2 obovatis parvis, sepalis 5 imbricatis viridibus obovatis 2 mm. longis et 1.5 mm. latis, petalis 5 obovatis 3.5–4.0 mm. longis et 2.5–3.0 mm. latis, staminibus 5, filamentis 2 mm. longis, antheris 1 mm. longis, ovariis rudimentariis; florum ♀ pedicellis 1.5–2.0 mm. longis, bracteis 2 minutis obtusis, sepalis 5 obovatis 2.5–3.0 mm. longis et 1.8–2.0 mm. latis, ovariis globosis 1.0–1.5 mm. latis, stylis 3 ad basin liberis; fructibus globosis 3.5 mm. latis.

Distribution: China (Yunnan), India (Burma).

China. yunnan: exact locality and date lacking, *G. Forrest 15692* (type, AA); *G. Forrest 8922, 8940, 11944, 17519, 21537; Y. Tsiang 13157; H. Handel-Mazzetti 8724; C. Schneider 2488, 2798; J. F. Rock 3157, 8066.*

Burma: *J. F. Rock 7406.*

Handel-Mazzetti, in working over material of Yunnan, encountered material from this species *(E. Handeliana)* and, interpreting it as *E. japonica* var. *aurescens* Rehder & Wilson, thought it sufficiently distinctive to be worthy of specific rank and called it *E. aurescens* (R. & W.) Handel-Mazzetti.

In the present paper, *E. japonica* var. *aurescens* is found to be more closely allied to *E. nitida* Korthals than to *E. japonica* Thunberg and has been transferred to *E. nitida* as *E. nitida* var. *aurescens* (R. & W.). According to the "International Rules" the name "*aurescens*" must be retained for material of the Rehder & Wilson concept and a new name must be given to this species. No name could be more fitting than that of Handel-Mazzetti himself, a renowned worker on Chinese botany, and it is a great pleasure to dedicate this species to him.

The truly remarkable feature of this species is the pronounced veining on the upper surface of the leaf. The veins, all, even including the small cross-veins, are deeply impressed giving the effect of etching. Students other than Handel-Mazzetti have been misled by the light yellow under-surface of the leaf and have interpreted the material as belonging to the present *E. nitida* var. *aurescens.* The calyx lobes in both the male and female flowers are bluish-green, at least in the herbarium specimens. Also the stamen number is five, while the style is three-parted.

7. **Eurya nitida** Korthals in Temminck, Verh. Nat. Gesch. Bot. 3: 115, t. 17 (1840).—Walpers, Repert. Bot. Syst. 1: 369(1842).—Choisy in Zollinger, Syst. Verz. Ind. Archip. 147(1854).—Blume, Mus. Bot. Lugd.-Bat. 2: 111(1856).—Miquel, Fl. Nederl. Ind. 1^2: 472(1859); in Ann. Mus. Bot. Lugd.-Bat. 4: 105(1868–69).—Merrill in Jour. Str. Br. Roy. As. Soc. (Spec. No.) 391(1921).—Handel-Mazzetti, Symb. Sin. 7^1: 399(1931).—Chun in Sunyatsenia, 2: 59(1934).—Rehder in Jour. Arnold Arb. 15: 99(1934).

Eurya Roxburghii Wallich, Num. List, No. 1465 (1828), pro parte.—Blume, Mus. Bot. Lugd.-Bat. 2: 113(1856).—Mueller in Walpers, Ann. Bot. Syst. 4: 344(1857).

Eurya Wightiana Wallich, Num. List, No. 3662 (1829), *nomen nudum.*

Eurya fasciculata Wallich, Num. List. No. 4399 (1830), *nomen nudum.*—Vesque in Bull. Soc. Bot. France, 42: 153(1895).

Eurya Zollingeri Choisy in Zollinger, Syst. Verz. Ind. Archip. 143, 147 (1854).—Mueller in Walpers, Ann. Bot. Syst. 4: 347(1857).—Miquel, Fl. Nederl. Ind. 1^2: 471(1859).—Koorders & Valeton, Bijdr. Boomsoorten Java, 3: 248(1896).

Eurya anceps Blume, Mus. Bot. Lugd.-Bat. 2: 111(1856).—Mueller in Walpers, Ann. Bot. Syst. 4: 344(1857).—Miquel, Fl. Nederl. Ind. 1^2: 472(1859).

Eurya myrtifolia Blume, Mus. Bot. Lugd.-Bat. 2: 113(1856).—Mueller in Walpers, Ann. Bot. Syst. 4: 344(1857).—Miquel, Fl. Nederl. Ind. 1^2: 473(1859).—Vesque in Bull. Soc. Bot. France, 42: 156(1895).

Eurya myrtifolia Blume var. *polymorpha* Blume, Mus. Bot. Lugd.-Bat. 2: 113(1856).

Eurya Hasseltii Blume, Mus. Bot. Lugd.-Bat. 2: 112(1856).—Mueller in Walpers, Ann. Bot. Syst. 4: 344(1857).—Miquel, Fl. Nederl. Ind. 1^2: 473(1859).—Koorders & Valeton, Bijdr. Boomsoorten Java, 3: 244(1896).

Eurya virens Blume, Mus. Bot. Lugd.-Bat. **2**: 112(1856).—Mueller in Walpers, Ann. Bot. Syst. **4**: 344(1857).—Miquel, Fl. Nederl. Ind. **1²**: 473(1859); Sumatra, 477(1862).

Eurya virens Blume var. *β. elliptica* Miquel, Sumatra, 477(1862).

Eurya japonica Thunberg var. *a. Thunbergii* Thwaites, Enum. Pl. Zeyl. 41(1864).

Eurya japonica Thunberg var. *nitida* Thiselton-Dyer in Hooker f., Fl. Brit. Ind. **1**: 284(1874).—Pierre, Fl. For. Cochinch. **2**: t. 126(1887).—Koorders & Valeton, Bijdr. Boomsoorten Java, **3**: 235(1896).—Pitard in Lecomte, Fl. Gén. Indo-Chine, **1**: 338(1910).—Rehder & Wilson in Sargent, Pl. Wilson. **2**: 398(1915).—Diels in Bot. Jahrb. **56**: 526(1921).—Rehder & Wilson in Jour. Arnold Arb. **8**: 177(1927).—Kanehira in Bot. Mag. Tokyo, **45**: 329(1931).

Eurya systyla Miquel ex Thiselton-Dyer in Hooker f., Fl. Brit. Ind. **1**: 284 (1874), pro synon.

Eurya myrtifolia Blume var. *a. anceps* (Blume) Vesque in Bull. Soc. Bot. France, **42**: 156(1895).

Eurya myrtifolia Blume var. *γ. virens* (Blume) Vesque in Bull. Soc. Bot. France **42**: 157(1895).

Eurya myrtifolia Blume var. *δ. Hasseltii* (Blume) Vesque in Bull. Soc. Bot. France, **42**: 157(1895).

Rapanea aurea Léveillé in Fedde, Rep. Spec. Nov. **10**: 376(1912); Fl. Kouy-Tchéou, 288(1914).

Eurya ladronica Hosakawa in Jour. Soc. Trop. Agric. **6**: 667(1934), *nomen nudum;* in Trans. Nat. Hist. Soc. Formosa, **25**: 30(1935).—Kanehira in Jour. Dept. Agric. Kyushu Imper. Univ. **4**: 370 (Enum. Micronesian Pl.) (1935).

Eurya palauensis Hosakawa in Trans. Nat. Hist. Soc. Formosa, **25**: 31(1935). —Kanehira in Jour. Dept. Agric. Kyushu Imper. Univ. **4**: 370 (Enum. Micronesian Pl.) (1935).

Eurya ponapensis Hosakawa in Trans. Nat. Hist. Soc. Formosa, **25**: 32(1935). —Kanehira in Jour. Dept. Agric. Kyushu Imper. Univ. **4**: 370 (Enum. Micronesian Pl.) (1935).

DISTRIBUTION: Dutch East Indies (Java, Sumatra, Borneo), Caroline and Marianne Islands, Philippine Islands (Palawan, Mindoro), Indo-China, India, China (Kwangtung, Hainan, Anhwei, Chekiang, Fukien, Hupeh, Kiangsu, Kwangsi, Kweichow, Szechuan, Yunnan).

BORNEO: locality and collector lacking (isotype of *E. nitida,* G, NY); *native collector 138, 870, 1878, 2685; J. & M. S. Clemens 20526, 20658, 20902; H. Hallier B764.*

JAVA: localities and collectors lacking (photos. and fragments of types of *E. Hasseltii, E. myrtifolia* and *E. anceps,* AA; isotypes of *E. anceps,* G, NY); *H. Zollinger 2119* (isotype of *E. Zollingeri,* FM).

SUMATRA: prope Pandan-dulu-enim, Prov. Palembang, *J. E. Teysmann* (isotype of *E. virens,* G); Bangka, *J. E. Teysmann* (isotype of *E. virens* var. *elliptica,* G); *H. O. Forbes 3116.*

PHILIPPINE ISLANDS. MINDORO: *M. L. Merritt, For. Bur. 6768; M. Ramos, Bur. Sci. 39637.*—PALAWAN: *G. Edano, Bur. Sci. 77451.*

CAROLINE and MARIANNE ISLANDS: *R. Kanehira 640, 702, 804, 1195, 1514, 1954, 2071, 2190.*

INDO-CHINA: *J. & M. S. Clemens 4218; A. Petelot 1545; J. Harmand 831.*

INDIA: *J. D. Hooker & T. Thomson s.n.; E. Johnson s.n.; Hocks s.n.; E. H. Wilson s.n.; L. L. Uhl s.n.; D. Prain 16; H. Tireman 21; W. Bembower 42, 77; W. Griffith 734, 735; D. Brandis 823; N. Wallich 4399* (isotype of *E. fasciculata*, NY); *F. K. Ward 9060; U. Kanjilal 4655; A. Saulière 55.*

CHINA. KWANGTUNG: *L. Tang 8359; Y. F. Kiang 9255; N. K. Chun 42826, 43039; W. Y. Chun 5130, 5290, 5853, 5898, 6093, 6837, 6838, 6844; H. Handel-Mazzetti 377; H. T. Ho 60176; S. P. Ko 50390, 52925, 53550, 54622, 54749; Y. Tsiang 173, 2340, 2638; S. P. Kwok 80065; S. K. Lau 2433, 2715, 25170; H. Y. Liang 61244, 61359; C. Wang & H. Y. Liang 31663, 31716; W. T. Tsang 16604, 20905; C. L. Tso 20772, 21622, 21759; C. Wang 30278, 30318, 32446, 37800, 38143; C. Wright s.n.; C. S. Sargent s.n.; C. Ford s.n.*—HAINAN: *N. K. Chun & C. L. Tso 43422, 43606, 43716; H. Fung 20129; F. C. How 71672, 73276; S. P. Ko 52186; S. K. Lau 1532, 2903, 3591; C. I. Lei 293, 398, 816; H. Y. Liang 61512, 62104, 64085, 64094, 64242, 64309, 64699, 64961, 63218, 63394, 65112, 66466, 66468; W. T. Tsang 60, 275, 276, 637, 23667; C. Wang 32885, 33206, 33503, 35715, 36289.*—CHEKIANG: *A. N. Steward 2435; T. N. Liou 7449; T. Tang 148; R. C. Ching 1333, 1649, 2024, 4836, 4916, 5176; M. Chen 627, 890; C. Y. Chiao 14214, 14368, 14433, 14516, 14523, 14575, 14676, 18840; H. H. Hu 251, 775, 1661; Y. L. Keng 137, 148, 171, 282, 566, 655, 744, 1055, 1098.*—ANHWEI: *N. K. Ip 4771; R. C. Ching 2694, 2908, 3016; M. Chen 1078; S. C. Sun 1207.*—KIANGSI: *H. H. Hu 2391; Y. Tsiang 10600,* in part; *W. Y. Chun 4304; E. H. Wilson 1572, 1579; A. N. Steward & H. C. Cheo 504.*—KIANGSU: *R. C. Ching & C. L. Tso 404, 431; W. Y. Chun 2604.*—HUNAN: *H. Handel-Mazzetti 467, 483, 11413.*—HUPEH: *H. C. Chow 754, 1751; E. H. Wilson* (Veitch) *1751, 3544; A. Henry 1907, 2344, 3687, 7946; W. Y. Chun 3710; H. C. Cheo & C. Y. Chiao 18178.*—KWANGSI: *A. N. Steward & H. C. Cheo 822, 863; R. C. Ching 5931; W. T. Tsang 22004; H. Y. Liang 67442; S. K. Lee 81067.*—KWEICHOW: *H. Handel-Mazzetti 145; S. W. Teng 684; Y. Tsiang 4181, 7721, 7521, 8598.*—FUKIEN: *H. H. Chung 2205, 2665, 3725, 4026, 6415; J. B. Norton 1576.*—YUNNAN: *E. E. Maire 113, 214, 2465; J. F. Rock 7548, 7867; G. Forrest 7573, 7598, 8021, 14829; Y. Tsiang 13077; H. Handel-Mazzetti 5708; H. T. Tsai 55756, 57130.*—SZECHUAN: *A. Henry 7099; C. Y. Hwang 171; W. P. Fang 504, 672, 2035, 2074, 2308, 2334, 2337, 5727; S. F. Chang 952; Y. Chen 5730; F. T. Wang 20576, 22492.*

This species, which was first described by Korthals from material grown in Sumatra, has a larger geographical range than most species in the genus. Found originally in the Dutch East Indies it extends north to the Philippine Islands and west into China where it is found in the majority of the southern and eastern provinces.

There is a variation to be found, naturally, in a species with such an extensive range. The Chinese material has heavier thicker leaves than the material found in the Dutch East Indies.

However, the variation is not sufficient to warrant specific or varietal delimitation.

Though often confused with *E. japonica* because both species are strictly glabrous, they can be separated easily by their geographical distributions. The range of *E. japonica* is limited to Japan only, while *E. nitida,* a widespread species, is never found there. Also *E. japonica* has an undulating, soft serration while the serration in *E. nitida* is sharp and close.

Eurya virens Blume, *E. myrtifolia* Blume, *E. Hasseltii* Blume and *E. anceps* Blume were reduced to synonomy under *E. nitida* by Miquel. The only one of the four that could be questioned is *E. anceps.* The leaves in this Javan representative are perhaps a little wider than typical *E. nitida,* hence taper a trifle more abruptly at the apex. However, I agree with Miquel and feel that this variation is hardly worthy of consideration.

Of *E. Zollingeri,* only a good-sized fragment of the type was available. This was found in the Field Museum of Natural History. It resembles *E. nitida* in all visible characters. However, no flowers or fruit were to be had. Choisy, in referring to the style, says "Stylus unicus apice 3-partitus." One naturally assumes that the style is elongated. In such a case the species would naturally fall into the synonomy of *E. nitida.*

Eurya ladronica, E. palauensis and *E. ponapensis,* all described by Hosakawa in 1935 from the Marianne and Caroline Islands, belong under this species. Kanehira in his enumeration of the Micronesian flora intimates in a footnote that after comparing a large number of specimens collected in the same regions as Hosakawa's species, he could find no striking differential characters. He merely mentions the proposed new species pending a more intensive study. I also have material (Kanehira's) from these localities, and although none are mentioned by Hosakawa in his study they are undoubtedly the same species.

True *E. nitida* is found in the Philippines on the islands of Palawan and Mindoro. Also a single specimen from the province Caramines Sur on the island of Luzon. However, the

majority of material from Luzon varies from the true *E. nitida* in having rather short styles free to the base. The majority of specimens are those with mature fruit in which the styles may have been broken off partly or entirely. These specimens may be worthy of specific delimitation but the consistent variation seems to be found in the style only and, as has been mentioned before, considerable variation in the style may be found on a single plant.

7a. **Eurya nitida** Korthals var. **aurescens** (Rehder & Wilson), comb. nov.

Eurya japonica Thunberg var. *aurescens* Rehder & Wilson in Sargent, Pl. Wilson. 2: 399(1915).

Eurya aurescens (Rehder & Wilson) Handel-Mazzetti, Symb. Sin. 7[4]: 400 (1931), quoad syn., excl. descript.

DISTRIBUTION: China (Hupeh, Kiangsu, Chekiang, Fukien, Kweichow, Szechuan, Kwangsi), Indo-China.

CHINA. HUPEH: woods, Changyang Hsien, alt. 600–1300 m., *E. H. Wilson 3545* (type, AA), April and September 1907 (shrub 2–6 m. tall; flowers white or pink; fruit black); *E. H. Wilson 22; H. C. Chow 1253, 1943, 1961; W. Y. Chun 3992, 4148; A. Henry 3673, 5147, 5162, 5170, 6693, 7830; H. C. Cheo 184.*—KIANGSU: *Y. Tsiang 9939, 10046, 10600* (in part); *H. H. Chung & S. C. Sun 502; C. Y. Cheo 18801; T. N. Hsiung 472.*—CHEKIANG: *C. Y. Chiao 14613.*—FUKIEN: *native collector for H. H. Chung 4001.*—KWEICHOW: *Y. Tsiang 6769, 7003.*—SZECHUAN: *W. P. Fang 2307, 2413, 3809, 5703, 5808, 7603, 7755; C. Bock & A. von Rosthorn 2165; A. Henry 5616.*—KWANGSI: *W. T. Tsang 21865.*

INDO-CHINA: *J. & M. S. Clemens 3451, 3927.*

This variety, very closely related to *E. nitida,* can be separated by its larger, generally thicker, coriaceous leaves, rounded at the base and abruptly short-acuminate at the apex. Usually the under-surface of the leaf is bright yellow. This last character does not always hold and may be found at times characteristic of individual specimens of *E. nitida* itself.

When originally described by Rehder and Wilson as *E. japonica* var. *aurescens,* their concept of *E. nitida* was that of a second variety of *E. japonica.* These authors noted the relationship between the two varieties and at that time seemed to be among the few botanists who actually felt that *E. japonica* was not native to China.

Handel-Mazzetti raised this variety to specific rank under the name *E. aurescens.* Unfortunately, Handel-Mazzetti was not working with representative material of this variety but with that of a new species *(E. Handeliana)* described in the present study.

8. **Eurya obliquifolia** Hemsley in Hooker's Icon. **28**: t. 2761 (1903).—Melchior in Engler & Prantl, Nat. Pflanzenfam. ed. 2, **21**: 148(1925).

DISTRIBUTION: China (Yunnan).

CHINA. YUNNAN: mountain forests, southwest of Mengtze, alt. 1525 m., *A. Henry 10914, 10914A, 10914B* (in part), (isotypes, AA, NY) (tree 10 m.); *Y. Tsiang 13078.*

This species is closely allied to *E. glandulosa.* It can be separated, however, by its larger leaves (up to 10 cm.) which are membranaceous rather than coriaceous and attenuate-acuminate at the apex. The leaves of *E. glandulosa* are decidedly revolute and from the upper surface appear entire. The leaf margins of *E. obliquifolia* are not revolute and are decidedly serrate.

9. **Eurya glandulosa** Merrill in Philipp. Jour. Sci. Bot. **12**: 107(1917).—Melchior in Engler & Prantl, Nat. Pflanzenfam. ed. 2, **21**: 148(1925).

Eurya Weissiae Chun in Jour. Arnold Arb. **9**: 128(1928).—**Syn. nov.**

DISTRIBUTION: China (Kwangtung, Kwangsi, Kweichow, Yunnan).

CHINA. KWANGTUNG: in damp, shaded ravines, alt. 1000 m., *E. D. Merrill 10379* (type, NY, photo. AA), Oct. 28, 1916; North River region, *W. Y. Chun 5791, 5791a* (types of *E. Weissiae),* Dec. 1927 (AA, SY).—KWANGSI: *R. C. Ching 5942.*—KWEICHOW: *Y. Tsiang 6258, 6259.*—YUNNAN: *H. T. Tsai 51739; Y. Tsiang 13344.*

Unfortunately the specimen from which Merrill drew up his original description for this species was older and generally less pronounced in character than the material used by Chun in his description of *E. Weissiae.* The variations between the two are those of degree rather than true morphological differences. On careful study of a series of specimens these differences vanish.

This species is characterized by terete stems, auriculate, coriaceous leaves (4–6 cm long, 1.5–3 cm. wide) with pronounced reticulate veining on the lower surface. These veins are impressed above. The young stems, terminal leaf-buds and calyx lobes are hirsute. The style is approximately 1 mm. long and connate for most its length.

It is closely related to *E. disticha* from which it can easily be separated by its coriaceous leaves, pronounced reticulate veining, leaf width and short style. A second related species is *E. obliquifolia* (Yunnan) which differs from *E. glandulosa* in its larger (up to 10 cm.) leaves, which are membranaceous rather than coriaceous, attenuate-acuminate at the apex, with serrated margins which are not revolute.

10. **Eurya emarginata** (Thunberg) Makino in Bot. Mag. Tokyo, **18**: 19(1904), excl. syn. *Eurya chinensis.*—Rehder & Wilson in Sargent, Pl. Wilson. **2**: 400(1915).—Mori, Enum. Corean Pl. 251(1922).—Makino & Nemoto, Fl. Jap. 552(1925). —Melchior in Engler & Prantl, Nat. Pflanzenfam. ed. 2, **21**: 148 (1925).—Nakai, Fl. Sylv. Kor. **17**: 81(1928).

Ilex emarginata Thunberg, Fl. Jap. 78(1784); in Murray, Syst. Veg. ed. 14, 168(1784).—Vitman, Summa Pl. **1**: 342(1789).—Willdenow, Sp. Pl. **1**: 170 (1798).—Persoon, Syn. Pl. **1**: 151(1805).—Poiret, Suppl. Encycl. **3**: 66 (1813).—Roemer & Shultes, Syst. Veg. **3**: 491(1818).—A. P. de Candolle, Prodr. **2**: 16(1825).—G. Don, Gen. Hist. **2**: 19(1832).—Miquel, Cat. Mus. Bot. Lugd.-Bat. 19(1870).

Eurya littoralis Siebold apud Siebold & Zuccarini in Abh. Akad. München. **4**[2]: 163 (Fl. Jap. Fam. Nat. **1**: 55) (1845), *nomen nudum.*

Eurya chinensis sensu Blume, Mus. Bot. Lugd.-Bat. **2**: 108(1856).—Miquel in Ann. Mus. Bot. Lugd.-Bat. **3**: 15(1866), in part.—Franchet & Savatier, Enum. Pl. Jap. **1**: 58(1875).—Hemsley in Jour. Linn. Soc. London, **23**: 76(1886), in part.—Nakai in Jour. Coll. Sci. Tokyo, **26**: 100(1909).—Non R. Brown.

DISTRIBUTION: Japan, Liu Kiu Islands, Korea, China (Chekiang, Fukien).

JAPAN: prope Nagasaki (type, Thunberg Herb., Upsala; photo. AA); *R. Oldham s.n.; C. J. Maximowicz s.n.; K. Sakurai s.n.*

LIU KIU ISLANDS: *U. Faurie 3821; E. H. Wilson 6057, 8043; R. Kanehira 3174, 3255, 3303, 3379; G. Masamune s.n.*

KOREA: *E. Taquet 2690, 2691; U. Faurie 493; E. H. Wilson 9555.*

CHINA. CHEKIANG: *K. K. Tsoong 116; R. C. Ching 1929.*—FUKIEN: *W. Y. Chun 8103; H. H. Chung 6201, 6356.*

This species was described originally by Thunberg (1784) as *Ilex emarginata* and was not transferred to *Eurya* until 1904 when Makino made the transfer. It is characterized as a shrub or small tree with thick, coriaceous, cuneate, obovate to oblong-obovate, emarginate leaves with revolute, crenate-serrate margins. The young branchlets are clothed with a short, rufous-brown villous tomentum.

Considered confined to Korea, Japan and Liu Kiu, only recently material collected in Fukien and Chekiang shows this species as inhabiting China as well.

10a. **Eurya emarginata** Makino var. **microphylla** Makino in Bot. Mag. Tokyo, **24**: 29(1910).

DISTRIBUTION: Japan (cultivated).

JAPAN: Cultivated, Kyoto, Yamasiro Prov., Hondo, *K. Shioto B978*, Aug. 31, 1915.

This fine cultivated variety of *E. emarginata* is characterized by very small obovate-orbicular, emarginate leaves. Makino states that the leaves are 3.0–9.0 mm. long, 2.5–7.0 mm. wide. In the specimen examined for this study none were found to be over 7.0 mm. long. Also there were no evidences of flowers or fruit on the specimen studied. Makino makes no mention of these same parts in his original description. The branchlets are many and softly puberulent; the small leaves are regularly distichous.

Because of its small leaves it might at first be mistaken for *E. japonica* var. *microphylla*. However, the latter variety has larger, oblong-obtuse leaves, rounded apex, not emarginate and is glabrous throughout.

11. **Eurya cuneata,** spec. nov.

Frutex vel arbor parva, ramis ramulisque teretibus firmis, ramulis novissimis et gemmis ultimis pubescentibus; foliis oblongo-obovatis ad elliptico-obovatis 6–9 cm. longis et 2.0–3.5 cm. latis utrinque glabris basi subtus excepta supra fusco-viridibus subtus pallide viridibus obtuse acuminatis subtus distincte cuneatis integerrimis vel fere integerrimis, petiolis 5

mm. longis; floribus axillaribus singularibus vel binis; florum ♂ pedicellis 4 mm. longis, sepalis 5 crassis imbricatis obtusis 3 mm. longis, petalis 5 ad basin conjunctis rotundatis obtusis 4.0–4.5 mm. longis, staminibus 15, filamentis gracilibus 1.5 mm. longis, antheris apiculatis 1.0 mm. longis, ovariis rudimentariis; florum ♀ pedicellis 1 mm. longis, sepalis 5 glabris crassis obtusis 1.5 mm. longis, corolla non visa, ovario glabro ovato 1.5 mm. longo et 1 mm. lato, stylis connatis apice trifidis 1.10 mm. longis; fructu non viso.

DISTRIBUTION: China (Hainan).

CHINA. HAINAN: in thickets, Tingon, Dung Ka, alt. 600 m., *N. K. Chun & C. L. Tso 44274* (holotype, AA), Nov. 17, 1932 (small tree 4 m. high; flowers white; bark brownish gray) (AA, NY); *H. Y. Liang 64174; F. C. How 73578, 73709; C. Wang 34659, 36048.*

This species is characterized by entire or nearly entire, oblong-obovate or elliptic-obovate leaves, and firm, terete branches and branchlets which are pubescent when young. This pubescence is found also on the terminal buds. In margin it resembles somewhat *E. Macartneyi.* However, it can be quickly distinguished from *E. Macartneyi* by its pubescent buds and branchlets. From the material examined this species is confined to the island of Hainan.

11a. **Eurya cuneata** Kobuski var. **glabra,** var. nov.

A typo recedit ultimis gemmis glabris.

DISTRIBUTION: China (Hainan).

CHINA. HAINAN: in forest, Mo San Leng, alt. 900 m., *N. K. Chun & C. L. Tso 44325* (type, AA), Nov. 22, 1932 (tree 8 m.; bark gray; leaves deep green, glabrous; flowers white, fragrant); *N. K. Chun & C. L. Tso 44290; C. Wang 35942; H. Y. Liang 64380, 64381.*

Like the species, this variety is found only on the island of Hainan. It resembles the species in all respects save that it is strictly glabrous even to the young stems and terminal buds. As in the species the stamen number is 15 and the petals are united at the base.

12. **Eurya Fangii** Rehder in Jour. Arnold Arb. **11:** 165 (1930).

DISTRIBUTION: China (Szechuan).

CHINA. SZECHUAN: in thickets, Omei hsien, Mt. Omei, alt. 2600–2750 m., *W. P. Fang 2917* (isotype, NY), Aug. 13, 1928 (shrub 1 m. tall); *E. Faber 662.*

This species is characterized by deeply impressed veins on the upper surface. Sharp points terminate the serrations on the leaves. Also distinctive are its hirsute branchlets and ciliolate sepals. The species is quite closely allied to *E. Handeliana* from which it differs especially in its smaller leaves and hirsute branchlets. Although occurring in both species the degree of vein impression is more pronounced in *E. Handeliana.*

13. **Eurya chinensis** R. Brown in Abel, Narr. Jour. China, 379, t.(1818).—DeCandolle, Prodr. **1**: 525(1824).—Champion in Hooker's, Jour. Bot. & Kew Gard. Misc. **3**: 307(1851); in Trans. Linn. Soc. London, **21**: 113(1855).—Seemann, Bot. Voy. Herald, 366(1857).—Szyszylowicz in Engler & Prantl, Nat. Pflanzenfam. III. **6**: 190(1893).—Dunn & Tutcher in Kew Bull. Misc. Inform. Add. Ser. **10**: 44 (Fl. Kwangtung & Hongkong)(1912).—Rehder & Wilson in Sargent, Pl. Wilson. **2**: 400(1915).

Eurya parvifolia Gardner in Calcutta Jour. Nat. Hist. **7**: 445(1847).
Eurya japonica Thunberg var. *δ. parvifolia* Thwaites, Enum. Pl. Zeyl. 41(1864).

DISTRIBUTION: China (Kwangtung, Fukien, Kwangsi, Yunnan), Formosa, Ceylon.

CHINA. KWANGTUNG: in fields, *C. Abel s.n.* (type in BM; photo. and fragment, AA); *K. Bushwell 6336; S. R. Chiang 155; N. K. Chun 40064, 40477, 42237, 42238, 42866, 43004, 44419; W. Y. Chun 5043, 5501, 5503, 5519, 5596, 5713, 6061, 6238, 6422, 7176; J. L. Gressitt 1264; S. Lam 9490; T. M. Tsui 167, 423; C. Wang 1851, 31989, 37609, 37783; W. T. Tutcher 987; Y. K. Wang 1821, 1851; K. K. Wang 337, 592; C. Wilford s.n.; C. Wright 54; S. K. Lau 668, 675, 2385, 24440, 25329; S. Y. Lau 20060; E. D. Merrill 10290; C. O. Levine 191, 206, 1474, 1836, 1922, 3296, 3495; S. P. Ko 53743, 53753; F. A. McClure 7091; H. F. Hance 497; F. C. How 71155; F. H. Hwang 9390, 9425, 9462; T. C. Lai 6, 45; H. Y. Liang 61843, 61866; C. S. Niu 8105; W. T. Tsang 4, 20166, 20338, 20534, 21610; Y. Tsiang 1139, 1146, 1602, 1729, 3298, 3554; C. L. Tso 20457, 21396, 21543.*—FUKIEN: *F. P. Metcalf 5917.*—YUNNAN: *G. Forrest 7663, 9367, 9689, 11728, 12209, 25334; H. T. Tsai 55608, 55965, 55971, 56484.*—KWANGSI: *S. T. Hwang 1025, 1122; R. C. Ching 7776, 8048, 8698; W. T. Tsang 22008, 23353; H. Y. Liang 67134, 67186; W. H. Soo 68212.*

FORMOSA: *S. Suzuki 3507; J. L. Gressitt 81; T. Tanaka 13474; U. Faurie 285, 292; G. Masamune & K. Mori s.n.; A. Henry 375, 1465.*

CEYLON: *Walker (C.P.) 784.*

The young branchlets and terminal buds are pubescent. The leaves are obovate, bluntly acuminate at apex, distinctly cuneate at base. The specimens are usually small-leafed, sometimes larger, however, always in proportion.

Eurya emarginata is similar to this species but can be separated by its heavier, coriaceous leaves which are always rounded-emarginate at the apex rather than bluntly acuminate. The leaf-margin in leaves of *E. emarginata* are also usually revolute.

The geographical distribution of *E. chinensis* seems very incomplete. However, when other states of China have been worked over and studied to the extent that the flora of Kwangtung has, the gaps in distribution, evident at present, will be filled in. This species must grow profusely because along with the original description the author, in discussing the landscape, remarked that it was covered with this species of *Eurya.*

14. **Eurya ceylanica** Wight, Ill. Indian Bot. **1**: 98(1838).—Gardner in Calcutta Jour. Nat. Hist. **7**: 444(1847).—Thiselton-Dyer in Hooker, f., Fl. Brit. Ind. **1**: 285(1874).

Eurya japonica Thunberg var. *γ. chinensis* Thwaites, Enum. Pl. Zeyl. 41(1864).

DISTRIBUTION: Ceylon.

CEYLON: *T. Thomson s.n.; E. Gardner 91; T. Petch s.n.*

Only four specimens were available for study. Two of these four (Thomson, Gardner) are quite authentic specimens and figured in the early literature of this species.

The species is characterized by heavy coriaceous leaves (4–6 cm. long, 1.5–2.5 cm. wide) with veins impressed on the upper surface and pronouncedly upraised on the lower surface. The margins are generally revolute and serrate for the upper three-quarters. Also the leaves are cuneate at the base and obtusely acuminate at the apex. The terminal bud is hairy, as are the younger branchlets and midrib of the leaves. The styles are short and recurved.

Because of its heavily veined reticulate under-surface of the leaves, this species at first resembles *E. glandulosa* Merrill. However, the distinctly cuneate base of the leaf, in contrast to

the lobed, subsessile base of *E. glandulosa,* immediately identifies it.

15. **Eurya acuminata** DeCandolle in Mém. Soc. Phys. Genève, **1**: 418 (Mém. Fam. Ternstroem. 26)(1822); Prodr. **1**: 525 (1824).—Wallich, Num. List, No. 1464(1828).—Royle, Ill. Bot. Himal. **1**: 127(1834); 2: t. 24(1839).—Walpers, Repert. Bot. Syst. **1**: 370(1842).—Blume, Mus. Bot. Lugd.-Bat. **2**: 117 (1856).—Mueller in Walpers, Ann. Bot. Syst. **4**: 345(1857).—Thiselton-Dyer in Hooker f., Fl. Brit. Ind. **1**: 285(1874).—Kurz in Jour. As. Soc. Bengal, **43**[2]: 91 (Burmese Fl.) (1874).—Theobold in Mason, Burma, **2**: 631(1883).—Trimen, Handb. Fl. Ceylon, **1**: 110(1893).—Szyszylowicz in Engler & Prantl, Nat. Pflanzenfam. III. **6**: 190(1893).—Kanjilal, For. Fl. School Circle, N-W.P. 31(1901); For. Fl. Siwalik & Jaunsar For. Div. U.-P. Agra & Oudh, 53(1911).—Strachey, Cat. Pl. Kumaon Adj. Port. Garhwal & Tibet, 22(1906).—Rehder & Wilson in Sargent, Pl. Wilson. **2**: 400(1915).—Ridley, Fl. Malay Pen. **1**: 199 (1922).—Melchior in Engler & Prantl, Nat. Pflanzenfam. ed. 2, **21**: 147(1925).—Osmaston, For. Fl. Kumaon, 42(1927).—Yamamoto in Sylvia, **5**: 38, fig. 23(1934).

Eurya multiflora DeCandolle in Mém. Soc. Phys. Genève, **1**: 417 (Mém. Fam. Ternstroem. 25)(1822); Prodr. **1**: 525(1824).

Geeria serrata Blume, Bijdr. Fl. Nederl. Ind. **3**: 124(1825).

Geeria serrata Blume var. *sericea* Blume, Bijdr. Fl. Nederl. Ind. **3**: 124(1825).

Geeria angustifolia Blume, Bijdr. Fl. Nederl. Ind. **3**: 125(1825).

Ternstroemia bifaria Hamilton ex D. Don, Prodr. Fl. Nepal. 145(1825), pro. synon.

Diospyros serrata Hamilton ex D. Don, Prodr. Fl. Nepal. 145(1825).

Eurya angustifolia Wallich, Num. List, no. 1465(1828), *nomen nudum.*—Walpers, Repert. Bot. Syst. **1**: 370(1842).

Eurya lucida Wallich, Num. List, no. 1462(1828), *nomen nudum.*—Blume, Mus. Bot. Lugd.-Bat. **2**: 118(1856).—Mueller in Walpers, Ann. Bot. Syst. **4**: 345(1857).

Eurya bifaria Wallich, Num. List, no. 3721(1829), *nomen. nudum.*

Eurya euprista Korthals in Temminck, Verh. Nat. Gesch. Bot. **3**: 113(1840).—Walpers, Repert. Bot. Syst. **1**: 369(1842).—Blume, Mus. Bot. Lugd.-Bat. **2**: 116(1856).—DeVries, Pl. Ind. Bat. Orient. Reinw. 28(1856).—Mueller in Walpers, Ann. Bot. Syst. **4**: 345(1857).—Miquel, Fl. Nederl. Ind. **1**[2]: 474 (1859).

Eurya Blumeana Korthals in Temminck, Verh. Nat. Gesch. Bot. **3**: 119(1840).—Walpers, Repert. Bot. Syst. **1**: 369(1842).—Blume, Mus. Bot. Lugd.-Bat.

2: 120(1856).—Mueller in Walpers, Ann. Bot. Syst. 4: 346(1857).—Miquel, Fl. Nederl. Ind. 1²: 475(1859).—Koorders & Valeton, Bijdr. Boomsoorten Java, 3: 245(1896).

Eurya serrata (Blume) Walpers, Repert. Bot. Syst. 1: 369(1842).—Blume, Mus. Bot. Lugd.-Bat. 2: 115(1856).—DeVries, Pl. Ind. Bat. Orient. Reinw. 29(1856).—Mueller in Walpers, Ann. Bot. Syst. 4: 345(1857).—Miquel, Fl. Nederl. Ind. 1²: 474(1859).—Mason, Burma People Prodr. 2: 631(1883).

Eurya angustifolia (Blume) Walpers, Repert. Bot. Syst. 1: 369(1842).—Blume, Mus. Bot. Lugd.-Bat. 2: 119(1856).—Mueller in Walpers, Ann. Bot. Syst. 4: 346(1857).—Miquel, Fl. Nederl. Ind. 1²: 475(1859).

Eurya membranacea Gardner in Calcutta Jour. Nat. Hist. 7: 444(1847).

Eurya phyllanthoides Blume, Mus. Bot. Lugd.-Bat. 2: 110(1856).—DeVries, Pl. Ind. Bat. Orient. Reinw. 27(1856).—Mueller in Walpers, Ann. Bot. Syst. 4: 343(1857).—Miquel, Fl. Nederl. Ind. 1²: 470(1859), "*E. phyllantoides*"; Ann. Mus. Bot. Lugd.-Bat. 4: 105(1868-69).—Vesque in Bull. Soc. Bot. France, 42: 153(1895).

Eurya phyllanthoides Blume var. *brevifolia* Blume, Mus. Bot. Lugd.-Bat. 2: 111(1856).—DeVries, Pl. Ind. Bat. Orient. Reinw. 28(1856).—Mueller in Walpers, Ann. Bot. Syst. 4: 343(1857).

Eurya serrata Walpers var. *firma* Blume, Mus. Bot. Lugd.-Bat. 2: 116(1856).—Mueller in Walpers, Ann. Bot. Syst. 4: 345(1857).

Eurya serrata Walpers var. *membranacea* Blume, Mus. Bot. Lugd.-Bat. 2: 116 (1856).—Mueller in Walpers, Ann. Bot. Syst. 4: 345(1857).

Eurya euprista Korthals β. var. *heteroidea* Blume, Mus. Bot. Lugd.-Bat. 2: 117 (1856).

Eurya acuminata DeCandolle var. *multiflora* Blume, Mus. Bot. Lugd.-Bat. 2: 117(1856).—Mueller in Walpers, Ann. Bot. Syst. 4: 345(1857).

Eurya Wallichiana Blume, Mus. Bot. Lugd.-Bat. 2: 118(1856), non Steudel.

Eurya salicifolia Blume, Mus. Bot. Lugd.-Bat. 2: 118(1856).—Mueller in Walpers, Ann. Bot. Syst. 4: 346(1857).

Eurya confinis Blume, Mus. Bot. Lugd.-Bat. 2: 119(1856).—Mueller in Walpers, Ann. Bot. Syst. 4: 346(1857).

Eurya confinis Blume var. *fusca* Blume, Mus. Bot. Lugd.-Bat. 2: 119(1856).—Mueller in Walpers, Ann. Bot. Syst. 4: 346(1857).

Eurya rostrata Blume, Mus. Bot. Lugd.-Bat. 2: 119(1856).—Miquel, Fl. Nederl. Ind. 1²: 475(1859).

Eurya clandestina Blume, Mus. Bot. Lugd.-Bat. 2: 121(1856).—Mueller in Walpers, Ann. Bot. Syst. 4: 346(1857).—Miquel, Fl. Nederl. Ind. 1²: 476 (1859).—Vesque in Bull. Soc. Bot. France, 42: 154(1895).

Eurya clandestina Blume var. *minor* Blume, Mus. Bot. Lugd.-Bat. 2: 121(1856).—Mueller in Walpers, Ann. Bot. Syst. 4: 347(1857).

Eurya hirsutula Miquel, Sumatra, 477(1862).

Eurya japonica Thunberg var. β. *acuminata* Thwaites, Enum. Pl. Zeyl. 41 (1864).

Eurya japonica Thunberg var. *phyllanthoides* (Blume) Thiselton-Dyer in Hooker f., Fl. Brit. Ind. 1: 284(1874).—Koorders & Valeton, Bijdr. Boomsoorten Java, 3: 237(1896).

Eurya acuminata DeCandolle var. *euprista* (Korthals) Thiselton-Dyer in

Hooker f., Fl. Brit. Ind. 1: 285(1874).—Pitard in Lecomte, Fl. Gén. Indo-Chine, 1: 339(1910).—Baker f., in Jour. Bot. **62**: suppl. 9(1924).

Eurya Wrayi King in Jour. As. Soc. Beng. **52**[2]: 196(1890).—**Syn. nov.**

Eurya acuminata DeCandolle var. *monticola* Ridley in Jour. Str. Br. Roy. As. Soc. **16**: 1(1912).—**Syn. nov.**

Eurya arisanensis Hayata, Icon. Pl. Formos. **8**: 6, fig. 4(1919).—Yamamoto in Jour. Soc. Trop. Agric. **5**: 348(1933).—Makino & Nemoto, Fl. Japan, ed. 2. 741(1931).—Yamamoto in Sylvia, **5**: 39, fig. 24(1934).—**Syn. nov.**

Eurya Matsudai Hayata, Icon. Pl. Formos. **9**: 6, fig. 5(1920).—Sasaki, List. Pl. Formos. 293(1928).—Makino & Nemoto, Fl. Japan, ed. 2. 742(1931).—Yamamoto in Jour. Soc. Trop. Agric. **5**: 349(1933); in Sylvia, **5**: 41, fig. 31(1934).—**Syn. nov.**

Eurya nitida Korthals var. *strigillosa* Handel-Mazzetti, Symb. Sin. **7**[1]: 400 (1931).—**Syn. nov.**

Eurya glaberrima Hayata var. *acuminata* Suzuki in Ann. Rept. Taihoku Bot. Gard. **1**: 158(1931).—**Syn. nov.**

Eurya Suzukii Yamamoto in Jour. Soc. Trop. Agric. **5**: 349(1933); in Sylvia, **5**: 42, fig. 34(1934).—**Syn. nov.**

DISTRIBUTION: India, Malay Peninsula, Ceylon, Java, Sumatra, Formosa, China (Szechuan, Yunnan).

INDIA: Nepal, *N. Wallich 1464*, in part (type; photo. and fragment, AA); *N. Wallich 1464*, in part (type of *E. multiflora;* photo. and fragment, AA); *N. Wallich 1462* (type of *E. lucida;* photo. and fragment, AA); *N. Wallich 1463* (type of *E. Roxburghii;* photo. and fragment, AA); *N. Wallich 3721* (type of *E. bifaria;* photo. and fragment, AA); *E. Gardner s.n.* (type of *E. nephalensis;* photo. and fragment, AA); *J. D. Hooker s.n.; J. D. Hooker & T. Thompson s.n.; B. Ram 152, 2335; A. E. Osmaston 216, 218; A. T. Gage 93; H. Singh 238; W. Griffith 738; N. E. Parry 845; R. N. Parker 2042, 2118; R. R. Stewart 11411, 13224.*

MALAY PENINSULA: Penang, *N. Wallich 1465* (type of *E. angustifolia;* photo. and fragment, AA); Perak, *L. Wray 1273* (type of *E. Wrayi;* photo. AA); Perak, *H. N. Ridley s.n.* (type of *E. acuminata* var. *monticola;* photo. and fragment, AA); *Haniff 227; A. C. Maingay 187, 1069; J. F. Rock 1807; M. R. Henderson 22670.*

CEYLON: *E. Gardner 92* (type of *E. membranacea;* photo. and fragment, AA); *G. Thwaites s.n.*

JAVA: Buitenzorg, *C. L. Blume s.n.* (isotype of *E. phyllanthoides,* AA, G, NY); *C. L. Blume s.n.* (isotype of *E. clandestina,* G, NY); *collectors unidentified* (isotype of *E. serrata,* NY; *E. serrata* var. *membranacea,* G; *E. serrata* var. *firma* G, NY; *E. serrata* var. *confinis,* photo. and fragment, AA; *E. clandestina* var. *minor,* G; *E. rostrata,* NY; *E. euprista,* NY); *W. H. de Vriese s.n.; J. E. Teysmann s.n.; Lobb s.n.; O. Warburg 3367, 3368.*

SUMATRA: Supajang Distr., *J. E. Teysmann s.n.* (isotype of *E. hirsutula,* G); *collector unidentified* (isotype of *E. euprista* var. *heteroidea,* G); *C. Hamel & R. S. Toroes 1161; B. A. Krukoff 325, 328, 4404; R. S. Toroes 155, 1570, 1733, 1874, 2193, 2389, 2742, 3017, 3996, 4352, 4414; H. S. Yates 804, 875, 1006, 1045, 1916, 1933, 2403; W. N. & C. M. Bangham 1094; H. O. Forbes 1941, 2482; H. H. Bartlett 7119, 7607, 7742, 8038, 8326.*

FORMOSA: *R. Kanehira 2847, 21163; U. Faurie 294, 1328, 1329; A. Henry 122; J. L. Gressitt 268, 274, 293; O. Warburg 9976; E. H. Wilson 9676, 9726, 10858.*

CHINA. SZECHUAN: *T. T. Yü 1533, 1775; F. T. Wang 22782.*—YUNNAN: *Y. Tsiang 11958, 12339; G. Forrest 22586; A. Henry 11171, 11414a; E. H. Wilson 4767; H. T. Tsai 54230, 54238, 54439, 56693, 57394, 57613, 57983, 58341, 58364, 59881, 59920.*

DeCandolle described *E. acuminata* and *E. multiflora* in the same publication with the latter name having page priority over the name accepted in this paper. However, since page priority no longer is considered a nomenclatorial rule the name *E. acuminata,* because of it long use in botanical literature, is accepted without hesitation. To use the name *E. multiflora* would confuse the literature of the species.

The synonyms cited in this paper are many. Most of these names have figured very little in botanical literature. The characters used in delimiting the species are very trivial and some species possess no seeming differences at all. Professor Rehder, of the Arboretum Staff, while on his recent visits to European herbaria searched diligently for types of this genus and returned with photographs and fragments of most of these species. They are deposited now in the herbarium of the Arnold Arboretum. These photographs and fragments have helped tremendously in working over this species.

Eurya Wrayi, E. arisanensis, E. Matsudai, E. glaberrima var. *acuminata, E. nitida* var. *strigillosa* and *E. Suzukii* are the modern species found in this study to be synonymous with *E. acuminata.* No discussion of these transfers is really necessary. The Formosan botanists before me have realized that their species were probably the same as *E. acuminata.* This they have shown by their recent determinations of Formosan material.

Eurya nitida var. *strigillosa* Handel-Mazzetti undoubtedly belongs to *E. acuminata,* resembling the species in all respects. The apex of the leaf may be a little less acuminate than usual, but in *Schneider 2702,* a paratype of var. *strigillosa,* the apex is typical. *Eurya nitida* is characterized by its strict absence of pubescence even to the terminal bud. Also the young stem is pronouncedly winged. In *E. nitida* var. *strigillosa,* as in *E. acuminata,* the branchlets are quite terete.

A photograph of the type of *E. Wrayi* King shows that

although the leaf base is perhaps a little less tapering than the majority of specimens of *E. acuminata,* this character, along with pointed leaf buds, not only fails to present enough basis for describing a new species but is not sufficiently varying for a variety.

15a. **Eurya acuminata** DeCandolle var. **Groffii** Merrill, comb. nov.

Eurya acuminata DeCandolle var. *multiflora* sensu Rehder & Wilson in Sargent, Pl. Wilson. **2**: 401(1915), non Blume.

Eurya Groffii Merrill in Philipp. Jour. Sci. **25**: 247(1919).—Melchior in Engler & Prantl, Nat. Pflanzenfam. ed. 2, **21**: 148(1925).

DISTRIBUTION: China (Kwangtung, Kweichow, Kwangsi, Szechuan, Yunnan).

CHINA. KWANGTUNG: on mountain sides, Tiu Kaan Shan, Tsen Uen, *G. W. Groff 2378* (holotype of *E. Groffii* Merr., NY); *H. T. Ho 60112; S. Lam 9511; H. Y. Liang 61827, 61829, 61844; C. Wang 30172, 30196, 37236, 38720; K. K. Wang 386, 1825; S. P. Ko 50111, 53624, 53739, 54606; H. Handel-Mazzetti 66; C. O. Levine 3159; W. T. Tsang 22945; N. K. Chun 41287; Y. Tsiang 540; F. C. How 72031; W. Y. Chun 5989; S. K. Lau 811; C. L. Tso 21393, 23746; T. M. Tsui 609.*—KWEICHOW: *Y. Tsiang 4363, 4647, 7219, 9208, 9233; A. N. Steward, C. Y. Chiao & H. C. Cheo 321.*—KWANGSI: *Y. C. Wang 5256; S. K. Lee 81252; S. P. Ko 55575, 55934, 55958, 56020; R. C. Ching 7251, 8174; W. H. Soo 68186, 68559, 69028; H. Y. Liang 65842, 65889, 66930, 67116.*—SZECHUAN: *E. H. Wilson (Veitch) 4768; W. P. Fang 2338.*—YUNNAN: *H. Handel-Mazzetti 2702* (iso-paratype of *E. nitida* var. *strigillosa* Hand.-Mazz., AA); *Y. Tsiang 12196, 12299, 12683, 13332; G. Forrest 7671, 9315, 16059; J. F. Rock 1997, 2461, 6996, 7072; A. Henry 9021, 10914B; H. T. Tsai 51526, 51768, 52460, 52596, 53134, 54213, 54615, 54828, 54945, 55385, 55673, 55840, 56491, 56661, 56772, 56949, 58863, 58946, 58973, 59114, 59153, 60417, 60679, 61049.*

The geographical range of *E. acuminata* is probably the most extensive of any species in the whole genus. Naturally, as expressed above, this species is also the most variable. In the case of this variety, the author has vacillated in his opinion whether to include it under the species or to recognize it as a separate variety. From the material at hand it appears that *E. acuminata* var. *Groffii* is confined to China while the species itself is found only occasionally in Szechuan and Yunnan.

This variety is the same as Rehder's interpretation of *E. acuminata* var. *multiflora.* The leaves, stems and calyx lobes are considerably more pubescent and the leaves are generally narrower, tapering gradually from base to apex. In the

species, the leaves swell toward the middle, tapering off abruptly.

16. **Eurya cerasifolia** (D. Don), comb. nov.

Diospyros cerasifolia D. Don, Prodr. Fl. Nepal. 144(1825).

Eurya symplocina Blume, Mus. Bot. Lugd.-Bat. 2: 144(1856).—Mueller in Walpers, Ann. Bot. Syst. 4: 345(1857).—Thiselton-Dyer in Hooker f., Fl. Brit. Ind. 1: 284(1874).—Kurz in Jour. As. Soc. Bengal. 43[2]: 91 (Burmese Fl.)(1874).—Theobold in Mason, Burma People Prodr. 2: 631(1883).—Vesque in Bull. Soc. Bot. France, 42: 154(1895).—Szyszylowicz in Engler & Prantl, Nat. Pflanzenfam. III. 6: 190(1893).—Duthie, Fl. Upper Gangetic Plain, 1: 74(1903).—Melchior in Engler & Prantl, Nat. Pflanzenfam. ed. 2, 21: 148(1925).

Eurya Wallichiana Planchon ex Thiselton-Dyer in Hooker f., Fl. Brit. Ind. 1: 285(1874), non Steudel.

DISTRIBUTION: India, Indo-China, China (Yunnan).

INDIA: Nepal, *N. Wallich 1464,* in part (type of *E. symplocina,* photo. and fragment, AA); *E. H. Wilson s.n.; J. D. Hooker s.n.; T. Thomson s.n.; L. F. Ruse 401; W. Griffith 787; J. S. Gamble s.n.; J. F. Rock 7486.*

INDO-CHINA: *A. Petelot 1518A.*

CHINA. YUNNAN: *J. F. Rock 7668; G. Forrest 881; H. T. Tsai 55002, 56882.*

The type specimen of *Diospyros cerasifolia* D. Don has not been seen by the author. This new combination has been made on the strength of Hooker's identification of *D. cerasifolia* with *Eurya symplocina,* since it is evident from the material studied that Hooker understood this species very well. The description of *D. cerasifolia* by Don is rather brief; he states that possibly it may be a new genus.

This close relative of *E. acuminata* is characterized by large leaves (10–13 cm. × 3–4 cm.), oblong-elliptic, entire or serrulate above, obtusely acuminate, usually membranaceous, appressed-pubescent beneath. The branchlets and terminal leaf-buds are pubescent.

17. **Eurya Loquaiana** Dunn in Jour. Linn. Soc. Bot. 38: 355 (1908).—Melchior in Engler & Prantl, Nat. Pflanzenfam. ed. 2, 21: 148(1925).

DISTRIBUTION: China (Fukien, Kwangtung, Hainan, Chekiang, Kwangsi, Kweichow, Szechuan).

CHINA. FUKIEN: in woods on mountain sides near Yenping, alt. 700 m., *LoQuai, (Hongkong Herb. no.) 2395* (holotype; photo. and fragment AA, NY); *H. H. Chung 2832, 3414.*—KWANGTUNG: *W. Y. Chun 5676, 5737, 7404; N. K. Chun*

41413, 42115, 42870, 42880; C. S. Niu 7999, 8003; S. P. Ko 50832, 50896, 51840, 51887, 53594, 53597; H. Y. Liang 60866, 61047; C. Wang 31036, 31278, 38133; C. Wang & H. Y. Liang 31276, 31321; S. K. Lau 916, 2013; Y. Tsiang 1353.—HAINAN: *C. Wang 35240; F. C. How 73276.*—CHEKIANG: *R. C. Ching 2569; C. Y. Chiao 14700.*—KWANGSI: *R. C. Ching 5721; W. T. Tsang 22778.*—KWEICHOW: *Y. Tsiang 4124, 4430, 4781, 4824, 4999, 5001, 5302, 5490, 6730, 7015, 7605, 7457, 7496, 7726, 7808, 9196, 9330.*—SZECHUAN: *W. P. Fang 2267, 5734; Y. Chen 5716.*

Dunn in his original description states that this species is entirely glabrous except for the flower-bud. As a result most workers have been placing material of the closely allied and strictly glabrous *E. nitida* under the name *E. Loquaiana.* A note on a leaf-tracing made from the type by E. D. Merrill while at Kew throws considerable light on the situation. ". . . styles fruit glabrous. Branchlets very slender, minutely puberulent." Here lies the answer! Instead of flower-buds being pubescent Dunn meant terminal leaf-buds. If the branchlets are puberulent, the leaf-buds in this genus also are puberulent. Material collected at the type locality was found to match perfectly with this new concept of *E. Loquaiana.*

The geographical range of this species is considerably extended to the states listed above.

Following is a description of the male flower made from specimen *C. Wang & H. Y. Liang, no. 31276,* collected in Kwangtung. Sepals 5, slightly pubescent, 1.25 mm. long, subtended by obtuse bracts; petals 5, joined at base, 4.5 mm. long, 2 mm. wide, rounded; stamens 10, filaments 2 mm. long, slender, anthers 1.25 mm. long, apiculate.

Besides the characters mentioned by Dunn, one of importance is the distinct veining on the under surface of the leaves. The veins are usually yellow and raised against the reddish-brown background of the leaf. This attractive meshwork is very noticeable and helpful in identifying the species.

18. **Eurya disticha** Chun in Sunyatsenia, 2: 52, pl. 15(1934); in Hu & Chun, Icon. Pl. Sin. 5: 5, pl. 205(1937).

DISTRIBUTION: China (Kwangtung).

CHINA. KWANGTUNG: on mountain top, Sunyi, *C. Wang 31000* (type, SY), July 20, 1931 (small shrub with deep blue fruit); *C. Wang 31949, 37887, 37894; N. K. Chun 42636; J. L. Gressitt 1259.*

A small shrub with distichous branches. The branchlets are subterete, the youngest parts densely covered with long brownish silky spreading hairs becoming glabrous with age. The leaves are chartaceous, 2-ranked, contiguous or nearly so, oblong, 2.0–3.5 cm. long, 0.7–1.0 cm. wide, auriculate at the base, clasping the stem; the basal lobes are rounded. The apex of the leaf is bluntly acuminate. The style is about 2 mm. long, trifid, joined for most the distance, at least in young flowers. The ovary is glabrous.

The male flowers evidently were not available when Chun drew up his description for the species. The following description is taken from flowers (♂) taken from *C. Wang, no. 37887.* The flowers are axillary usually one to an axil, with a pedicel about 1.5 mm. long. The bracts are minute, oblong, tipped by dark glands. The calyx consisting of 5 sepals is very small for the genus, 1.0 mm. long. The sepals are tipped at the apex by a conspicuous dark gland appearing at first glance as a mucron. This glandular character may have been unnoticed by Chun but it is present in the ♀ flower as well. The 5 petals are approximately 4.5 mm. long, 2.0–2.25 mm. wide, oblong, emarginate at the apex. There are 10 stamens; the filaments are 2.5 mm. long while the anthers are 1.5 mm. long. These latter are apiculate at the apex. Present also is a rudimentary ovary.

19. **Eurya trichocarpa** Korthals in Temminck, Verh. Nat. Gesch. Bot. **3**: 114(1840).—Blume, Mus. Bot. Lugd.-Bat. **2**: 115(1856).—Miquel, Fl. Nederl. Ind. **1**^{2}: 473(1859); in Ann. Mus. Bot. Lugd.-Bat. **4**: 105(1868–69).—Thiselton-Dyer in Hooker f., Fl. Brit. Ind. **1**: 285(1874).—Szyszylowicz in Engler & Prantl, Nat Pflanzenfam. III. **6**: 190(1893).—Vesque in Bull. Soc. Bot. France, **42**: 161(1895).—Ridley, Fl. Malay. Pen. **1**: 200(1922).—Melchior in Engler & Prantl, Nat. Pflanzenfam. ed. 2, **21**: 148(1925).

Eurya trichogyna Blume, Mus. Bot. Lugd.-Bat. **2**: 114(1856).—Mueller in Walpers, Ann. Bot. Syst. **4**: 345(1857).

Eurya acuminatissima Merrill & Chun in Sunyatsenia, **1**: 72(1930).—Handel-Mazzetti in Beih. Bot. Centralbl. **48**: 309(1931).—Chun in Hu & Chun, Icon. Pl. Sin. **5**: 4, pl. 204(1937).—**Syn. nov.**

DISTRIBUTION: Amboina, Borneo, Philippine Islands, India, Indo-China, China (Kwangtung, Kwangsi).

AMBOINA: *Zippel s.n.* (type; photo. and fragment, AA).

BORNEO: *J. & M. S. Clemens 22336, 26166, 26283, 26374, 27705, 29739, 30196, 34020, 34456, 35092; M. S. Clemens 1597, 2022, 9827.*

PHILIPPINE ISLANDS. MINDANAO: *A. D. E. Elmer 10871, 10872, 11467.*—LUZON: *F. Canicosa (For. Bur. No.) 30303; M. Ramos & G. Edano (Bur. Sci. no.) 38727, 38965, 43893.*

INDIA: *W. Griffith 736.*

INDO-CHINA: *A. Petelot 3781, 3882, 4310.*

CHINA. KWANGTUNG: in open, on side of mountain, Yingtak, *C. Wang 516* (type of *E. acuminatissima)*, Jan. 14, 1929; *H. Y. Liang 60839, 61165, 61263, 61354, 61355; C. Wang 32150, 38578; C. Wang & H. Y. Liang 31323; Z. S. Chung 11099; W. H. Soo 68141; S. P. Ko 50809, 53507, 53741, 53783; W. T. Tsang 20644, 20885; J. L. Gressitt 1367, 1541; C. L. Tso 20579, 20697, 22693; S. K. Lau 23925, 25221; W. Y. Chun 5899; S. P. Kwok 80128; N. K. Chun 40025, 41844, 41897, 42026, 42874, 42906; R. Mell 765.*—KWANGSI: *W. T. Tsang 22342, 22670, 22739, 23281; R. C. Ching 8377.*

This species is probably one of the most misunderstood in the genus. Usually it is glanced at casually and labeled *E. acuminata.* The outstanding feature is its pubescent ovary. At anthesis the ovary is covered with a mass of silvery-white, silky hairs. During maturity the fruit becomes glabrescent and in some cases it is very difficult to distinguish the species. During anthesis, when the calyx-lobes have just opened, the corolla is usually conical in shape. The leaves are caudate-acuminate, entire for some distance above the cuneate base and throughout the acumen but usually serrulate from the lower one-third to the base of the acumen. The style is trifid and united.

20. **Eurya velutina** Chun in Sunyatsenia, **2**: 57(1934); in Hu & Chun, Icon. Pl. Sin. **5**: 9, pl. 209(1937).

DISTRIBUTION: China (Kwangtung).

CHINA. KWANGTUNG: in mixed woods, Sunyi Distr., *C. Wang 30903* (isotype, AA); July 14–August 20, 1931 (tree 12 m. tall; leaves green above, paler beneath; fruit green, pubescent); *C. Wang 31786, 37925.*

This species is characterized by its large, ellipsoid, pilose fruit, its long style (4 mm.) which apparently is connate for most its length, its stout branches with 1–4 large fruits maturing together. Chun refers to the branches as angular. To me

they seem more terete or perhaps subterete in contrast to the distinctly angular branches of several other species. The large elliptic-oblong leaves (12–15 cm. long, 4–5 cm. wide) on the stout stem, the size of the tree (36–80 ft.), along with the other robust characters, make this species very outstanding in the genus.

21. **Eurya distichophylla** Hemsley in Jour. Linn. Soc. Bot. **23**: 77(1886).—Szyszylowicz in Engler & Prantl, Nat. Pflanzenfam. III. **6**: 190(1893).—Dunn & Tutcher in Kew Bull. Misc. Inform. Add. Ser. (Fl. Kwangtung & Hongkong), **10**: 43(1912).—Melchior in Engler & Prantl, Nat. Pflanzenfam. ed. 2, **21**: 148(1925).

Eurya Swinglei Merrill in Philipp. Jour. Sci. Bot. **12**: 106(1917).—Melchior in Engler & Prantl, Nat. Pflanzenfam. ed. 2, **21**: 148(1925).—Handel-Mazzetti in Beih. Bot. Centralbl. **48**: 310(1931).—**Syn. nov.**

DISTRIBUTION: China (Fukien, Kwangtung, Kiangsi, Kwangsi, Kweichow).

CHINA. FUKIEN: Amoy, *R. Swinhoe s.n.* (type; photo. and fragment, AA). —KWANGTUNG: Loh Fau Mt., *Merrill 10233* (holotype of *E. Swinglei*), Oct. 28, 1916; *R. Mell 680; C. O. Levine 1995; W. Y. Chun 6334; E. D. Merrill 10766; W. T. Tsang 20151, 21010, 21168, 21524; C. L. Tso 21635; S. K. Lau 24427, 25004, 25050; C. Wang 30913, 31608, 31617, 31874, 37302, 37865, 37868; N. K. Chun 41096, 41293, 43012, 43040; H. T. Ho 60031.*—KIANGSI: *Y. Tsiang 10242.*—KWANGSI: *S. K. Lee 81273; W. T. Tsang 22818, 23173; H. Y. Liang 67412.*—KWEICHOW: *Y. Tsiang 4659, 4993, 4995, 5780, 5961, 6296, 7751; S. Y. Teng 1408, 10636.*

This species is one of the few characterized by pubescent ovaries and fruit. In the flower the ovary is silky villous and possesses an elongated style which is connate for part its length. Upon maturity the fruit, unlike its near relative *E. trichocarpa,* does not become glabrescent but possesses longish straggling hairs. The leaves are subsessile and are arranged distichously on the stem. *Eurya distichophylla* was based on male flowers. The female flowers were described under *E. Swinglei* by Merrill and at the time thought to belong to a new species.

21a. **Eurya distichophylla** Hemsley var. **Henryi** (Hemsley), comb. nov.

Eurya Henryi Hemsley in Hooker's Icon. **28**: sub t. 2761(1903).—Melchior in Engler & Prantl, Nat. Pflanzenfam. ed. 2, **21**: 148(1925).

DISTRIBUTION: China (Yunnan).

CHINA. YUNNAN: mountains to the east of Mengtze, alt. 2135 m., *A. Henry 11342* (isotype of *E. Henryi*, AA, NY); *H. T. Tsai 51563, 51682, 62650; Y. Tsiang 13253.*

This variety, originally described as *E. Henryi*, can be distinguished from *E. distichophylla* only by its glabrous calyx. From the material examined, it seems to be confined to the state of Yunnan.

22. **Eurya ciliata** Merrill in Philipp. Jour. Sci. **23**: 253 (1923); in Lingnan Sci. Jour. **5**: 130(1927).

Eurya patentipila Chun in Sunyatsenia, **2**: 56(1934); in Hu & Chun, Icon. Pl. Sin. **5**: 6, pl. 206(1937).—Syn. nov.

DISTRIBUTION: China (Hainan, Kwangtung, Kwangsi).

CHINA. HAINAN: Ng Chi Leng, *F. A. McClure 9319* (holotype, NY), April 28, 1922; *N. K. Chun 44009, 44048; W. T. Tsang & H. Fung 643; H. Fung 20184; C. Wang 33508, 34527; H. Y. Liang 62272, 62278, 62618, 64701, 65339; F. C. How 71984, 73311, 73754.*—KWANGTUNG: shrub in thickets, *S. P. Lo 50831* (isotype of *E. patentipila*, AA), Nov. 10, 1930; *C. Wang 31149, 32122, 38001, 38013.*—KWANGSI: *R. C. Ching 7126; W. T. Tsang 22852; H. Y. Liang 67402; Kwangsi Museum 178.*

The young branchlets are densely covered with long spreading silky yellowish hairs becoming glabrescent with age. The leaves are coriaceous, short-petioled or subsessile, oblong-lanceolate, 5–9 cm. long, 2.0–2.5 cm. wide, rounded-oblique at the base, minutely cordatulate, gradually acuminate at the apex, densely long-pilose pubescent on the midrib with the veins obscure on both surfaces. The fruit (fide Chun) is ovoid-globose, 4.0–5.5 mm. long, scattered pilose. The style is glabrous, 4 mm. or more long, usually 4-fid, filiform, free. The calyx and ovary are densely pubescent.

In comparing the types of *E. ciliata* and *E. patentipila*, no differences could be found to possibly distinguish them as separate species.

23. **Eurya strigillosa** Hayata in Jour. Coll. Sci. Tokyo, **25**: Art. 19. 61(1908).—Kanehira, Formos. Trees, 57, f. (1917).—Yamamoto in Sylvia, **5**: 42, f. 33(1934).—Makino & Nemoto, Fl. Japan, ed. 2, 743(1931).

DISTRIBUTION: Formosa.

FORMOSA: *R. Kanehira 2933, 21187; U. Faurie 288, 1325.*

In pubescence and leaf-shape this species is very similar to *E. ciliata* of Hainan and Kwangtung. The ovary and fruit are invested with stiff hairs. Here it resembles also *E. gnaphalocarpa* and *E. trichocarpa*. However, unlike the last two species, whose stems are glabrous or nearly so, *E. strigillosa* has strong strigillose hairs along the branchlets and on the terminal bud.

24. **Eurya gnaphalocarpa** Hayata, Icon. Pl. Formos. **8**: 7, f. 5(1919).—Yamamoto in Sylvia, **5**: 40, f. 27(1934).

DISTRIBUTION: Formosa, Philippine Islands.
FORMOSA: *U. Faurie 1328*, in part; *E. H. Wilson 10845*.
PHILIPPINE ISLANDS. LUZON: *M. Ramos 76998*.—SABTANG: *M. Ramos 79879*.

Resembling *E. trichocarpa* in its pubescent ovary, this species differs in leaf characters and floral parts. In *E. trichocarpa* the leaves are somewhat narrower and taper off abruptly at first and then are drawn out more finely to an attenuate apex. In this species the apex is less attenuate and the tapering off is very gradual. In the male flowers, a rudimentary, pilose ovary is present. This species was confined formerly to Formosa but in this study the range has been extended south through Sabtang Island to Cayayan Province, Luzon.

25. **Eurya leptophylla** Hayata, Icon. Pl. Formos. **9**: 5, f. 4(1920).—Yamamoto in Sylvia, **5**: 41, f. 30(1934).—Suzuki in Ann. Rept. Taihoku Bot. Gard. **1**: 158(1931).

DISTRIBUTION: Formosa.
FORMOSA: *E. H. Wilson 9868, 10938*; *U. Faurie 289, 291, 1214, 1330, 1332*; *R. Kanehira 21198*.

The leaves in *E. leptophylla* are small for the genus, being 3–3.5 cm. × 1–1.5 cm. At the same time they are quite membranaceous and oblong-lanceolate. The male flowers have 7–8 stamens and the styles in the female flowers are columniform; these may or may not split to near the base.

26. **Eurya crenatifolia** (Yamamoto), comb. nov.

Pseudoeurya crenatifolia Yamamoto in Jour. Soc. Trop. Agric. **5**: 351(1933); in Sylvia, **5**: 43, f. 36(1934).

DISTRIBUTION: Formosa.

FORMOSA: in monte Taiheizan, *S. Suzuki s.n.* (fragment of paratype, AA); *T. Tanaka & Y. Shimada 17764; E. H. Wilson 10177; J. L. Gressitt 420.*

Yamamoto first described this species under the genus *Pseudoeurya.* The outstanding feature of this new *Eurya* was the pentandrous male flowers. This character, unusual perhaps for Formosan euryas, is quite prevalent in the genus throughout the Pacific Islands, especially in New Guinea and the Fiji Islands, and alone is not worthy of generic status. However, this opinion is now shared with the original author who discussed this situation with me during his recent visit to this Arboretum. At the same time, he kindly gave me a fragment of one of the paratypes for the species.

The female flowers have very short styles and in fruit these persistent styles seem almost non-existent, the stigmas curving immediately away from the fruit.

Closely allied to this species is *E. leptophylla.* However, in the latter species the styles are longer and the stamen number is 7–8. The leaves are generally larger, more membranaceous and attenuate at the apex.

27. **Eurya yaeyamensis** Masamune in Jap. Soc. Pres. Landsc. Hist. Nat. Mon. **8**: 24(1933); in Trans. Nat. Hist. Soc. Formosa, **24**: 209(1934).

DISTRIBUTION: Liu Kiu Islands (Iriomote).

LIU KIU ISLANDS. IRIOMOTE: *R. Kanehira 3148* (isotype, NY), Dec. 30, 1933; jungle stream, alt. 100 m., *J. L. Gressitt 587,* Aug. 1934 (shrub 4 m.).

In drawing up his original description, Masamune neglected to stress a few points which are given here. The leaf size is 8.0–12.0 cm. long, 3.0–4.0 cm. wide. He states that the petiole is 4 mm. long. In the specimens studied here, the petiole is found to be as much as 10 mm. long. Masamune also states that there are six sepals, rarely five or seven. I find five sepals in all the flowers dissected. Also, instead of "about 16 stamens" as found by Masamune, I find the general number of twenty.

This species seems to be a gigantic *E. zigzag.* Unfortunately, I have not had a chance to study *E. zigzag.* Masamune recently, in discussing the genus with me, offered to send typical material of this species along with other representative

material from the Liu Kiu Islands. This will form the basic material for a supplementary study of *Eurya* in these interesting islands.

28. **Eurya zigzag** Masamune in Jour. Soc. Trop. Agric. **2**: 48 (1930).

Distribution: Liu Kiu Islands.
No Specimen Examined.

This species, although not studied from actual material, is undoubtedly one of good standing. Actual specimens will be received for study from Masamune when the genus as represented on the Liu Kiu Islands will be studied. It resembles very much *E. yaeyamensis* Masamune. The zigzag and winged stems and branchlets are common to both. The leaves in *E. zigzag* are oblong to oblong-lanceolate and the size 8 × 2.25 cm. These are considerably smaller than the leaves of *E. yaeyamensis*. *Eurya zigzag* has 10 stamens which are 3 mm. long, with anthers twice the length of the filaments. *Eurya yaeyamensis* has 20 stamens which are 6 mm. long, with the filaments twice as long as the anthers.

29. **Eurya glaberrima** Hayata, Icon. Pl. Formos. **8**: 8, f. 6(1919).—Yamamoto in Sylvia, **5**: 39, f. 26(1934).—Suzuki in Ann. Rept. Taihoku Bot. Gard. **1**: 158(1931).

Distribution: Formosa.
Formosa: *S. Suzuki 2558; J. L. Gressitt 416; E. H. Wilson 9717, 10914; R. Kanehira 2911; R. Kanehira & S. Sasaki 32, 21713; H. H. Bartlett 6343; U. Faurie 287, 290.*

This species is characterized by probably one of the shortest styles in *Eurya*. Hayata describes the style as being 0.25 mm. long. The calyx, style and stigma (fide Hayata) are purple in the pistillate flower. The leaves are coriaceous, linear-lanceolate, 6–8 cm. long, 1–2 cm. wide, slightly emarginate, finely but sharply serrate. As the name signifies the whole plant is "very" glabrous.

30. **Eurya Hayatai** Yamamoto in Jour. Soc. Trop. Agric. **5**: 348(1933); in Sylvia, **5**: 40, f. 28(1934).

Distribution: Formosa.
Formosa: *E. H. Wilson 9809, 10882.*

The veining on the leaves, except for the midrib, is obscure. This smooth, seemingly unveined leaf surface is one of the outstanding features of the species. Also on the revolute or near-revolute margins, the serration is so finely crenate that the appearance of entirety is given in most cases. The whole plant, even to the terminal bud, is glabrous.

31. **Eurya japonica** Thunberg, Nov. Gen. Pl. 68(1783); Fl. Jap. 191, pl. 25(1784).—Lamarck, Encycl. Méth. Bot. **2**: 440(1788); Tabl. Encycl. Méth. **2**: 521, pl. 401(1793).—DeCandolle, Prodr. **1**: 525(1824).—Hooker & Arnott, Bot. Beech. Voy. 260(1836–40).—Siebold & Zuccarini in Abh. Akad. Münch. **4**[2]: 163 (Fl. Jap. Fam. Nat. **1**: 55)(1845).—Blume, Mus. Bot. Lugd.-Bat. **2**: 105(1856).—Miquel in Ann. Mus. Bot. Lugd.-Bat. **3**: 14(1866); Prol. Fl. Jap. 202(1867).—Franchet & Savatier, Enum. Pl. Jap. **1**: 57(1875).—Ito & Kaku, Fig. & Descript. Pl. Koishikawa Bot. Gard. Tokyo, **2**: pl. 19(1883).—Y. Tanaka, Useful Pl. Jap. 164, pl. 663(1895).—Szyszylowicz in Engler & Prantl, Nat. Pflanzenfam. III. **6**: 190(1893).—Ito & Matsumura in Jour. Coll. Sci. Tokyo, **12**: 326(1900).—Matsumura & Hayata in Jour. Coll. Sci. Tokyo, **22**: 46(1906).—Hayata in Jour. Coll. Sci. Tokyo, **25**: Art. 19, 60(1908).—Shirasawa, Ic. Ess. For. Jap. **2**: pl. 53(1908).—Schneider, Ill. Handb. Laubholzk. **2**: 329, f. 611 (f–k^2)(1912).—Rehder & Wilson in Sargent, Pl. Wilson. **2**: 398(1915).—Melchior in Engler & Prantl, Nat. Pflanzenfam. ed. 2, **21**: 148 (1925).—Makino & Nemoto, Fl. Japan, ed. 2, 742(1931).—Yamamoto in Sylvia, **5**: 40, f. 29(1934).

Eurya uniflora Siebold ex Siebold & Zuccarini in Abh. Akad. Münch. **4**[2]: 163 (Fl. Jap. Fam. Nat. **1**: 55)(1845), *nomen nudum.*

Eurya hortensis Siebold, l.c. (1845), *nomen nudum.*

Eurya montana Siebold, l.c. (1845), *nomen nudum.*—Mueller in Walpers, Ann. Bot. Syst. **4**: 342(1857).

Eurya japonica Thunberg var. *uniflora* Blume, Mus. Bot. Lugd.-Bat. **2**: 106 (1856).

Eurya japonica Thunberg var. *montana* Blume, l.c. (1856).

Eurya japonica Thunberg var. *hortensis* Blume, l.c. (1856).

Eurya crispa Siebold ex Blume, l.c. (1856), pro synon. *E. japonica* var. *hortensis* forma *b.*

Eurya japonica Thunberg var. *pusilla* Blume, l.c. 107(1856).

Eurya pusilla Siebold ex Blume, l.c. (1856), pro synon. *E. japonica* var. *pusilla*.

Eurya japonica Thunberg var. *multiflora* Miquel in Ann. Mus. Bot. Lugd.-Bat. 3: 14(1866); Prol. Fl. Jap. 202(1867).

Eurya latifolia Hort. ex C. Koch, Dendrol. 1: 490(1869).

? *Eurya Jacquemartii* Carrière in Rev. Hort. (1869) 369, f. 79.—Quihou in Bull. Soc. Accl. Paris, sér. 2, 6: 472, f. 3(1869).

Eurya japonica α *Thunbergii* (non Thwaites) Ito & Matsumura in Jour. Coll. Sci. Tokyo, 12: 326(1900).—fide Nakai.

DISTRIBUTION: Japan, Korea, Formosa.

JAPAN: *E. H. Wilson 6166, 6130, 6212, 6250, 6302, 7810; C. S. Sargent s.n.; R. Oldham 92, 139; Z. Tashiro s.n.; C. L. Blume s.n.; K. Sakurai s.n.; C. J. Maximowicz s.n.; T. Tanaka s.n.; S. Arimoto s.n.; G. Masamune s.n.*

LIU KIU ISLANDS: *E. H. Wilson 8136; R. Kanehira 3364; H. Mayr s.n.; C. Wright 29.*

FORMOSA: *R. Kanehira 3137; U. Faurie 492, 494, 1645; E. Taquet 2687, 2688, 2689; C. Wilford s.n.; E. H. Wilson 9366, 9442.*

There has been considerable confusion over the identity of this species. From the material at hand, the range of distribution is rather confined, having been collected only in Japan, the adjacent northern Liu-Kiu Islands, Korea and Quelpaert Island. Early in its history the geographical range (due to a confusion of species) was extended erroneously to include nearly all states of China, India, Malaysia and even the Oceanic Islands. This erroneously determined material belonged mostly to *E. nitida* and since this latter material was more plentiful, nearly all subsequent determinations of *E. nitida* made by comparison were incorrectly called *E. japonica*. The real basis of relationship between these species is the extreme glabrous condition throughout the plant, even to the leaf-buds. The outstanding distinguishing character of *E. japonica* other than its glabrosity is its smooth leaf serrations along with its emarginate apex.

Undoubtedly there are various garden forms of this species. The only variety treated in this paper is *E. japonica* var. *microphylla*. Of the others no material is available for study, and mention of these variations in literature is seldom made. Of *E. Jacquemartii* no material has been seen. However, the fact that its origin is listed as Japan and also since the inadequate description does state that the serration is undulate, a detail brought out in the rough illustration, I feel quite certain that

it is straight *E. japonica* or one of the forms of this diversified species. It is listed in this paper as a synonym rather than as a dubious species.

Ito & Kaku, in 'Fig. and Descript. Pl. Koishikawa Bot. Gard. Tokyo **2**: t. 19(1883),' say that in the mountains where this species is abundant, the odor is so strong (disagreeable) at the time of flowering as to make one feel quite uncomfortable. E. H. Wilson also spoke of this strong, unpleasant odor. Ito remarks that the fruit is usually black, sometimes white, however—and a solution made from the ash of the tree is used as a mordant in dyeing.

31a. **Eurya japonica** Thunberg var. **microphylla** (Siebold) Blume, Mus. Bot. Lugd.-Bat. **2**: 107(1856).—Makino & Tanaka, Man. Fl. Nippon, 357(1927).

Eurya microphylla Siebold ex Siebold & Zuccarini in Abh. Akad. Münch. **4**[2]: 163 (Fl. Jap. Fam. Nat. **1**: 55)(1845), *nomen nudum*.

Eurya japonica Thunberg f. *θ. pumila* Miquel in Ann. Mus. Bot. Lugd.-Bat. **3**: 14(1886); Prol. Fl. Jap. 202(1867).

Eurya pumila Siebold ex Miquel in Ann. Mus. Bot. Lugd.-Bat. **3**: 14(1866); Prol. Fl. Jap. 202(1867), pro. synon. *E. japonica* var. *pumila*.

DISTRIBUTION: Japan (cultivated).

JAPAN: cultivated in garden, Nagasaki, *C. J. Maximowicz s.n.*

This variety, like the species, is strictly glabrous even to the terminal bud. The leaves are oblong-obovate, 1.0–2.0 cm. long, ca. 0.5 cm. wide. The apex is blunt and rounded. The serrated margin is similar to that of the species but in the variety, because of the minute size of the leaves, the serrations (6–12 for whole leaf) appear more sharp. This variety can easily be separated from *E. emarginata* var. *microphylla* whose leaves are suborbicular, deeply emarginate, less than 1 cm. long, and whose branchlets are puberulent.

32. **Eurya rengechiensis** Yamamoto in Jour. Soc. Trop. Agric. **5**: 55(1933); in Sylvia, **5**: 41, f. 32(1934).

DISTRIBUTION: Formosa.

FORMOSA: Rengechi, Prov. Taichu, *Y. Yamamoto & K. Mori s.n.* (type; fragment, AA), Nov. 2–3, 1932.

This is probably the most robust species found in Formosa. The leaves are oblanceolate, 7–8 cm. long, 2.5–3.5 cm. wide; the

widest leaf of the genus in Formosa. The revolute margin is minutely serrulate giving an entire appearance. There are 12–15 pairs of veins which are attached to the midrib at an angle of 60 degrees. These veins are deeply impressed on the upper surface and raised on the lower surface.

A fragment of the type was graciously given the author by Dr. Yamamoto during his recent visit to the Arboretum.

33. **Eurya amplexicaulis** S. Moore in Jour. Bot. **37**: 168 (1899).—Merrill, Enum. Philipp. Fl. Pl. **3**: 74(1923).—Melchior in Engler & Prantl, Nat. Pflanzenfam. ed. 2, **21**: 148 (1925).

Eurya auriculata Elmer, Leafl. Philipp. Bot. **2**: 501(1908).

DISTRIBUTION: Philippine Islands (Mindoro, Negros).

PHILIPPINE ISLANDS. MINDORO: Mt. Dulangau, *J. Whitehead s.n.* (holotype; photo. AA); Mt. Halcon, *E. D. Merrill 545*, Nov. 1906.—NEGROS: Dumaguete (Cuernos Mts.), *A. D. E. Elmer 9544* (isotype of *E. auriculata*, AA, NY), March 1908.

This species stands out from all other species in the Philippines because of its sessile, clasping, auriculate leaves. The only other species similar to it in the whole genus is *E. amplexifolia* Dunn which is found in Kwangtung.

34. **Eurya buxifolia** Merrill in Philipp. Jour. Sci. Bot. **5**: 362(1910); Enum. Philipp. Fl. Pl. **3**: 74(1923).—Melchior in Engler & Prantl, Nat. Pflanzenfam. ed. 2, **21**: 148(1925).

DISTRIBUTION: Philippine Islands (Luzon).

PHILIPPINE ISLANDS. LUZON: *M. S. Clemens 17199; M. Ramos (Bur. Sci. no.) 5834; A. D. E. Elmer 8802; J. K. Santos (Bur. Sci. no.) 31719; E. Quisumbing & M. Sulit (Bur. Sci. no.) 82343; M. Ramos & G. Edano (Bur. Sci. no.) 37675; W. Klemme (For. Bur. no.) 5674.*

This species is confined to the island of Luzon and is characterized by terete branches, pubescent terminal buds, small coriaceous leaves up to 2.5 cm. long, nearly sessile (petiole up to 1 mm.) and styles very short, free to the base. Its nearest relative is *E. flava.*

35. **Eurya flava** Merrill ex Melchior in Engler & Prantl, Nat. Pflanzenfam. ed. 2, **21**: 148(1925).

Frutex (probabiliter) vel arbor parva, ramis ramulisque

alatis, gemmis ultimis pubescentibus; foliis oblongo-ellipticis ad oblongo-ovatis apice acuminatis basin cuneatis 2.5–5.0 cm. longis et 1.2–2.3 cm. latis subtus fere flavo-viridibus, costis juvenilibus pubescentibus, marginibus serrulatis, petiolis 2–3 mm. longis; floribus ♀ axillaribus solitariis vel binis, pedicellis brevibus pubescentibus, calycibus pubescentibus; fructibus immaturis globosis 2 mm. latis, stylis 3 ad basin liberis persistentibus brevissimis 1 mm. longis.

DISTRIBUTION: Philippine Islands (Luzon, Sorsogon, Mindanao, Palawan, Leyte, Batan).

PHILIPPINE ISLANDS. LUZON: Benguet Subprov., *E. D. Merrill 1737* (type, NY, G), May 1914; *E. D. Merrill 4648; A. D. E. Elmer 5910, 6813, 8361, 8767, 22292; R. S. Williams 731, 1212; T. E. Borden 270; H. N. Whitford 1192; A. Loher 86; H. M. Curran & M. L. Merritt (For. Bur. no.) 7848; M. Dirige (Bur. Agr. no.) 18633; R. Meyer (For. Bur. no.) 2641; M. Vanoverbergh 324; R. M. Holman 23; M. Ramos & G. Edano (Bur. Sci. nos.) 37788, 37968, 45015.*—SORSOGON: *A. D. E. Elmer 16748; M. Ramos (Bur. Sci. no.) 77118.*—MINDANAO: *A. D. E. Elmer 11442; E. D. Merrill 6188.*—PALAWAN: *A. D. E. Elmer 13199.*—LEYTE: *M. Ramos (Bur. Sci. no.) 41553; C. A. Wenzel 895.*—BATAN: *M. Ramos (Bur. Sci. nos.) 80023, 80289, 80695.*

This species was first recognized by Merrill and given the herbarium name *Eurya flava.* However, no description of the species was ever published by Merrill. Melchior, in working up the Theaceae for Engler & Prantl, 'Nat. Pflanzenfam.' (see above), mentions the species as though it were valid in a key to the Philippine euryas. The description in the present treatment is drawn from the actual specimens which were to have been used by Merrill for the types. This is done to avoid any further confusion. The flowers in the type specimens are too small for use in a detailed description, hence the following descriptions of the flowers are drawn from specimens other than the types. For the male flowers, *M. Ramos, no. 80289* is used: flowers axillary, single or in pairs, subtended by 2 small obtuse bracts, pedicel up to 3 mm. long, pubescent; calyx with 5 imbricated sepals, coriaceous-membranaceous at margin, 3.5 mm. long, 2 mm. wide; corolla of 5 obovate petals, rounded at apex, 4.5–5.0 mm. long, 3 mm. wide; stamens ca. 20, anthers 1 mm. long, filaments twice the anther length. For the female flowers, *Ramos & Edano no. 37788* is used: flowers axillary, single or in pairs, subtended by linear bracts 0.5 mm. long, pedicel pubes-

cent, up to 1.5 mm. long; calyx of 5 imbricated sepals, coriaceous, membranaceous at margin, 1.5 mm. long; corolla consisting of 5 petals, obtuse, rounded at apex, 2.0–2.5 mm. long, 1.5 mm. wide; ovary globose, glabrous, 1.2 mm. across, style trifid, 0.25 mm. long, free to the base.

36. **Eurya coriacea** Merrill in Philipp. Jour. Sci. Bot. **5**: 361 (1910); Enum. Philipp. Fl. Pl. **3**: 74(1923).—Melchior in Engler & Prantl, Nat. Pflanzenfam. ed. 2, **21**: 148(1925).

Eurya pachyphylla Merrill in Philipp. Jour. Sci. Bot. **13**: 309(1918); Enum. Philipp. Fl. Pl. **3**: 74(1923).—Melchior in Engler & Prantl, Nat. Pflanzenfam. ed. 2, **21**: 148(1925).—**Syn. nov.**

Eurya pachyrachis Merrill in Philipp. Jour. Sci. Bot. **13**: 310(1918); Enum. Philipp. Fl. Pl. **3**: 74(1923).—Melchior in Engler & Prantl, Nat. Pflanzenfam. ed. 2, **21**: 148(1925).—**Syn. nov.**

Distribution: Philippine Islands (Luzon).

Philippine Islands. luzon: *M. Ramos & G. Edano (Bur Sci nos.) 26525* (isotype of *E. pachyphylla*, NY, AA), *26579* (isotype of *E. pachyrachis*, AA), *28473, 33310, 38092, 40456, 45693; M. Ramos (Bur. Sci. nos.) 5598, 23565; G. Edano (Bur. Sci. no.) 75951; A. D. E. Elmer 8642; H. M. Curran, M. L. Merritt & T. C. Zschokke (For. Bur. no.) 18052.*

This species, confined to the island of Luzon, is characterized by terete stems, glabrous throughout, glabrous terminal buds, very short styles free to the base, and coriaceous or subcoriaceous leaves. *Eurya pachyrachis* was based primarily on a peculiar formation of the pedicel bases of the flowers, evidently persistent from season to season and was interpreted as a racemose inflorescence. This condition is found in other species of *Eurya* and often on an occasional specimen. In other respects it is a true *E. coriacea. Eurya pachyphylla* was originally separated from *E. coriacea* by its shorter petioles and glabrous sepals. Occasionally some of the sepals of *E. coriacea* are ciliate. However, this does not hold true for all specimens in the species.

37. **Eurya Pickeringii** A. Gray, Bot. U. S. Expl. Exped. 1838–1842, **1**: 211(1854).—Mueller in Walpers, Ann. Bot. Syst. **4**: 348(1857).

Distribution: Samoa.

Samoa: on mountains, Tuituila, alt. 600 m., *U. S. South Pacific Expl. Exped. 1838–1842 s.n.* (type, G); Asama, back of Sologa, Savaii, *F. Vaupel 372*, Aug. 18, 1905.

This species, along with *E. Richii* and *E. vitiensis,* is poorly represented in western herbaria. Even though possessing the types, the specimens are so poor that it is difficult to recognize relationships. A. Gray uses this species and the following species as a basis for his subgenus Euryodes based on the pentandrous staminate flowers. This character is hardly sufficient for sectional delimitation since one finds all numbers of stamens varying from 5 to 10 to 15 etc. One would find it necessary to make a subgenus for each stamen group to correspond with Gray's 5-stamened section, and this would not be feasible.

38. **Eurya Richii** A. Gray, Bot. U. S. Explor. Exped. 1838–1842, **1**: 212(1854).—Mueller in Walpers, Ann. Bot. Syst. **4**: 348(1857).

Eurya sanguinea Vesque in Bull. Soc. Bot. France, **42**: 159(1895).

DISTRIBUTION: Samoa.

SAMOA: Upolu, *C. Pickering s.n.* (type G; isotype NY); *S. J. Whitmee s.n.; Betche s.n.* (type of *E. sanguinea;* photo. and fragment, AA).

Like *E. Pickeringii,* this species is characterized by pentandrous staminate flowers. The main character of separation from *E. Pickeringii,* which is found on the same island, is its pubescence.

A photograph of the type specimen of *E. sanguinea* was examined. This examination coupled with a study of the description, showed *E. sanguinea* to be the pistillate counterpart of *E. Richii.*

39. **Eurya vitiensis** A. Gray, Bot. U. S. Explor. Exped. 1838–1842, **1**: 210(1854).—Seemann, Fl. Vitiensis, 14(1865).—Anon. in Gartenfl. **36**: 130(1887).

DISTRIBUTION: Fiji Islands.

FIJI ISLANDS: on the summit of a mountain of Ovolau, alt. 600 m., *U. S. South Pacific Expl. Exped. 1838–1842 s.n.* (type, G, NY); *B. Seemann s.n.; W. H. Harvey s.n.; J. Horne s.n.*

A. Gray in his original description writes of this species as being "very glabrous even to the ultimate branches." This is hardly correct. Even on the type specimen (determination in A. Gray's handwriting) pubescence is found on the terminal

buds, young stems and petioles. The species is further characterized by an ovoid, pointed ovary. Gray remarks that the anthers are cuspidate-pointed. This is often characteristic of species in the genus. No suitable flowers could be had for dissection.

40. **Eurya glabra** (Blume) Korthals in Temminck, Verh. Nat. Gesch. Bot. **3**: 114(1840).—Blume, Mus. Bot. Lugd.-Bat. **2**: 109(1856).—De Vries, Pl. Ind. Bat. Orient. Reinw. 28(1856). —Mueller in Walpers, Ann. Bot. Syst. **4**: 343(1857).—Miquel, Fl. Nederl. Ind. **1**^{2}: 472(1859); in Ann. Mus. Bot. Lugd.-Bat. **4**: 104(1868–69).—Vesque in Bull. Soc. Bot. France, **42**: 153 (1895).—Koorders & Valeton, Bijdr. Boomsoorten Java, **3**: 240(1896).—Baker f. in Jour. Bot. **62**: suppl. 8(1924).—Melchior in Engler & Prantl, Nat. Pflanzenfam. ed. 2, **21**: 147 (1925).

Geeria glabra Blume, Bijdr. Fl. Nederl. Ind. **3**: 125(1825).
Eurya tristyla Wight & Arnott, Prodr. 86(1834).—Walpers, Repert. Bot. Syst. **1**: 369(1842).

DISTRIBUTION: Java.
JAVA: exact locality and collector uncertain (isotype G, NY; photo. and fragment, AA); *O. Warburg 3365; O. Kuntze 5746; H. S. Yates 2675.*

In 1825 Blume described this species as *Geeria glabra.* In the same publication *Geeria obovata* was also described by him. Later in 1842, Korthals transferred both species to *Eurya.* Strangely enough, although Korthals is credited with the binomial *Eurya obovata,* authors have ignored the other binomial, *Eurya glabra,* made at the same time by Korthals and have credited the changed name to Blume in his publication twelve years later, 1856. Even "Index Kewensis" has credited one combination to Blume and the other to Korthals.

41. **Eurya coneocarpa** Korthals in Temminck, Verh. Nat. Gesch. Bot. **3**: 117(1840).—Walpers, Repert. Bot. Syst. **1**: 369 (1842).—Blume, Mus. Bot. Lugd.-Bat. **2**: 108(1856).—Mueller in Walpers, Ann. Bot. Syst. **4**: 343(1857).—Miquel, Fl. Nederl. Ind. **1**^{2}: 471(1859).—Vesque in Bull. Soc. Bot. France, **42**: 155 (1895).

Eurya japonica Thunberg var. *Thunbergii* Koorders & Valeton, Bijdr. Boomsoorten Java, **3**: 234(1896).—Non Thwaites, Enum. Pl. Zeylan. 41(1864).

Eurya japonica Thunberg var. *coneocarpa* Hochreutiner in Candollea, **2**: 434 (1925).

DISTRIBUTION: Java.

JAVA: locality lacking, *P. W. Korthals s.n.* (isotype, NY, G; photo. and fragment, AA); *O. Warburg 3364; H. S. Yates 2760; E. Meyer s.n.*

Eurya coneocarpa is characterized by unequal and alternate bracts, turbinate or top-shaped fruit (globose-ovoid) and flower buds quite conic in shape because of the abruptly acuminate calyx lobes.

Koorders & Valeton, in referring *E. coneocarpa* to *E. japonica* var. *Thunbergii*, definitely had true *E. coneocarpa* in mind. They refer to the young branchlets as "ramulis ultimis angulatis glabris," which is a true character. On the other hand, Thwaites describes the branches "ramulis teretibus glabris," which does not apply to this species.

42. **Eurya obovata** (Blume) Korthals in Temminck, Verh. Nat. Gesch. Bot. **3**: 118(1840).—Walpers, Repert. Bot. Syst. **1**: 369(1842).—Blume, Mus. Bot. Lugd.-Bat. **2**: 107(1856).—De Vries, Pl. Ind. Bat. Orient. Reinw. 27(1856).—Mueller in Walpers, Ann. Bot. Syst. **4**: 342(1857).—Miquel, Fl. Nederl. Ind. **1**^{2}: 470(1859).—Vesque in Bull. Soc. Bot. France, **42**: 154 (1895).—Koorders & Valeton, Bijdr. Boomsoorten Java, **3**: 242(1896).

Geeria obovata Blume, Bijdr. Fl. Nederl. Ind. **3**: 125(1825).

Eurya reticulata Korthals in Temminck, Verh. Nat. Gesch. Bot. **3**: 118(1840). —Walpers, Repert. Bot. Syst. **1**: 369(1842).—Blume, Mus. Bot. Lugd.-Bat. **2**: 107(1856).—Mueller in Walpers, Ann. Bot. Syst. **4**: 342(1857).—Miquel, Fl. Nederl. Ind. **1**^{2}: 471(1859).—Baker f. in Jour. Bot. **62**: suppl. 9 (1924).—Merrill in Contrib. Arnold Arb. **8**: 107(1934).

Eurya obovata var. *elliptica* Blume, Mus. Bot. Lugd-Bat. **2**: 107(1856).—Mueller in Walpers, Ann. Bot. Syst. **4**: 342(1857).

DISTRIBUTION: Celebes, Java (fide Korthals), Sumatra, Borneo.

CELEBES: in monte Klabat, collector lacking (type; photo. and fragment, AA); on top of Lomphobatang, Gowa, alt. 2700–2850 m., *Neth. Ind. For. Service s.n.*, Sept. 9, 1935.

SUMATRA: locality and collector lacking (isotype of *E. obovata* var. *elliptica*, G); locality and collector lacking (isotype of *E. reticulata*; photo. and fragment, AA); *H. O. Forbes 2393.*

BORNEO. MT. KINABALU: *J. & M. S. Clemens 27883, 28990, 29881, 30347, 33108, 33789, 50813, 50879, 50986; M. S. Clemens 10634, 10666.*

Most of the recent workers have used the name *E. reticulata* rather than *E. obovata* when designating this species. These two names appeared under the genus *Eurya* simultaneously (1840) and on the same page. However, *E. obovata* (Bl.) Korthals is merely a transfer from the genus *Geeria* to *Eurya* and as such has precedence over the name *E. reticulata* which was appearing for the first time.

42a. **Eurya obovata** Korthals var. **sinaboengensis**, var. nov. A specie typica differt foliis oblongo-ellipticis.

DISTRIBUTION: Sumatra.

SUMATRA: wooded belt (light jungle) slightly below center of volcano Sinaboeng, alt. at peak 2550 m., *W. N. & C. M. Bangham 1180* (type, AA), Feb. 23, 1932 (shrub 3 m.; fruit green) (AA, NY); Deleng Si Naboen (ascent from Kampong Goeroe Kinajan), Karoland, *H. H. Bartlett 8650*, June 25–26, 1927.

This variety found on the slopes of the volcano Sinaboeng (Si Naboen) resembles *E. obovata* in all respects except leaf shape. Instead of being obovate, rounded-obtuse, the leaves of the variety are oblong-elliptic, tapering at both ends.

43. **Eurya Roemeri** C. Lauterbach in Nova Guinea, 8^4: 842 (1912).—Melchior in Engler & Prantl, Nat. Pflanzenfam. ed. 2, 21: 148(1925).

DISTRIBUTION: New Guinea.

NEW GUINEA: lowlands of the Hellwig Mts., Dutch New Guinea, 750 m., *L. von Roemer 848* (type; photo. and fragment, AA), Nov. 1909.

Lauterbach described this species quite completely and stated that the female flower possessed 3 styles and 3 stigmas. In general appearance, *E. Roemeri* resembles more closely the haplostemonous group of New Guinea rather than the many-stamened group of the rest of the genus. One wonders how much material the author possessed in drawing up his description because the photograph of the type is a woefully poor specimen. Even so, from this fragmentary material it stands by itself as a species.

44. **Eurya Greenmaniana**, spec. nov.

Arbor parva, ramulis teretibus dense pilis fulvis adpressis vestitis; foliis coriaceis distichis ovatis 2.0–3.0 cm. longis et 0.7–1.0 cm. latis acuminatis basi rotundatis ad truncatis gla-

bris subtus sericeo-pilosis acute serratis, breviter petiolatis; floribus ♀ axillaribus 1–3, sepalis 5 inaequalibus 1.0–1.5 mm. longis, petalis albidis inaequalibus 3 mm. longis 2 mm. latis, ovario globoso glabro, stylis 3 brevibus ad basin liberis, stigmatibus truncatis; fructu ignoto.

DISTRIBUTION: New Guinea.

NEW GUINEA. BRITISH NEW GUINEA: common at fringes and interior of forests, Murray Pass, Wharton Range, Central Distr., alt. 2840 m., *L. J. Brass 4744* (type, AA), June–Sept. 1933.

Small tree of open-branching habit, branchlets terete, stiff, same diameter throughout, not tapering as is usually the case. The young branchlets and leaves are clothed with a dense fulvous somewhat appressed pilose pubescence. The older leaves are quite glabrous except on the midrib, coriaceous, distichous, ovate, rounded or truncate at the base, acute at the apex, sharply serrate, very short-petiolate or subsessile. The female flowers are found singly or in clusters of two or three in the axils of the leaves. These are bi-bracteolate. The ovary is quite globose, glabrous, topped by a short trifid style, free to the base.

This interesting species is quite distinct from most Papuan species. It resembles more the distichous species of China, especially *E. disticha* from which it differs in having the style and stigma 5-parted instead of 3-parted and its leaves with rotund base, acuminate apex and sharp serration.

It is a pleasure to name this species in honor of Dr. Jesse More Greenman, long a loyal friend and advisor.

Subgenus PENTEURYA

Eurya subgenus **Penteurya,** subgen. nov.

45. **Eurya Hellwigii** Lauterbach in Nova Guinea, **8**[4]: 841 (1912).—Melchior in Engler & Prantl, Nat. Pflanzenfam. ed. 2, **21**: 148 (1925).

DISTRIBUTION: New Guinea.

NEW GUINEA: summit of the Hellwig Mts., Southwest New Guinea, alt. 2500 m., *L. von Roemer 1249* (type; photo. in AA), Nov. 1909; common on forest fringes, Mt. Albert Edward, Central Division, British New Guinea, alt. 3680 m., *L. J. Brass 4264*, May–July, 1933 (tree, 3–5 m., with stiff spreading branches; branchlets reddish; leaves yellowish beneath; flowers white).

Lauterbach in his original description says that the styles in this species are trifid. In dissections on the flowers of *Brass 4264* there are five distinct stigmas and the styles are 5-fid. This may intimate that the Brass specimen is perhaps a new species. However, in all other respects it agrees with this species. I feel that had Lauterbach possessed better material he would have discovered, perhaps, the parts of the female flower in fives rather than threes, since this is the condition found in most of the New Guinea species.

46. **Eurya albiflora** White in Proc. Roy. Soc. Queensland, **39**: 66, pl. 4, fig. 2(1928).

Eurya oreogena Diels in Bot. Jahrb. **62**: 483(1929).—**Syn. nov.**

Distribution: New Guinea.
No Specimens Examined.

Even though no specimens of this species and *E. oreogena* were examined, the descriptions given by the two individual authors, White and Diels, were so well drawn up that it is quite evident that the species is quite distinct and also that both authors had the same species in mind. White described *E. albiflora* one year previous to Diels' *E. oreogena*. Accompanying White's description is an excellent plate. The only discrepancy in the descriptions is found in the number of stamens. White describes *E. albiflora* as having 5 stamens while Diels says that *E. oreogena* has 8–9. Probably there may be a variation in stamen number in the species.

I am of the opinion that the types of both species were collected at the same locality. *Eurya oreogena* was collected at Saruwaged-Gebirge in Northwest New Guinea at 12000 ft., while *E. albiflora* was collected at Sarawaket at 10000 ft.

There is a great resemblance between this species and *Eurya Hellwigii*. However, *E. albiflora* is much more densely pubescent, in fact tomentose, than *E. Hellwigii*. Also the leaf-base in *E. albiflora* is cordate (fide author), while that of *E. Hellwigii* is cuneate or subrotund. The leaves in this species, according to White, are 1.0–1.7 cm. long, decidedly smaller than *E. Hellwigii*. It is assumed that the style of *E. albiflora* is five-fid because of the number of stamens and its relation to other New

Guinea species. This assumption may prove erroneous when female flowers are found and examined.

47. **Eurya Merrilliana**, spec. nov.

Arbor vel frutex 3–5 m. altus, ramis initio pilosis demum glabratis; foliis ovatis 4–6 cm. longis et 2–3 cm. latis coriaceis abrupte acuminatis, acumine emarginato, basi cuneatis supra glabris subtus pilosis serratis venis elevatis perpendicularibus 10–12 paribus, breviter petiolatis, petiolis 2–3 mm. longis; floribus ♂ axillaribus solitariis raro geminatis, pedicellis 3–4 mm. longis; sepalis 5, petalis 5 albidis inaequalibus, staminibus 5; floribus ♀ ovario globoso glabro, stylis connatis, stigmatibus 5; fructibus baccatis glabris globosis.

DISTRIBUTION: New Guinea.

NEW GUINEA. BRITISH NEW GUINEA: common in forest fringe growth, Murray Pass, Wharton Range, Central Division, alt. 2840 m., *L. J. Brass 4660* (type, AA), June–Sept., 1933 (small tree 3–5 m. with smooth shining leaves, white flowers and slightly compressed, purple fruit); same general locality, alt. 2840 m., *L. J. Brass 4575*, June–Sept. 1933 (small tree or large bush, 2–4 m.; flowers white).

Four normal stamens plus one double stamen make a most interesting character in this species. In all flowers examined this same condition existed. In the double stamen the two filaments were connate the entire length topped by two individual anthers. In the female flowers the style is almost nil. Very short, less than 1 mm., it is topped by five stigmas.

The leaves are shining-smooth, heavy-coriaceous, ovate, 4–6 cm. long, 2–3 cm. wide, tapering very abruptly at both ends, emarginate, sparingly pubescent on lower surface, short-petioled. The terminal leaf-buds and midrib are very hirsute, covered with tan pubescence. The stems are gray, pubescent when young and terete.

It is a pleasure to name this distinct and interesting species in honor of Dr. E. D. Merrill, Director of the Arnold Arboretum, ardent worker in the Pacific Islands flora and a scientist whose interest and assistance in the study of this genus have been most helpful.

48. **Eurya tigang** Schumann & Lauterbach, Fl. Deutsch. Schutzgeb. Südsee, 447(1901).—Diels in Bot. Jahrb. **57**: 434

(1922).—Melchior in Engler & Prantl, Nat. Pflanzenfam. ed. 2, **21**: 148 (1925).

DISTRIBUTION: New Guinea.

NEW GUINEA: Sattelberg, Kaiser Wilhelm Land, *Bamler 24* (type; photo. and fragment, AA), Dec. 24, 1898.

When originally described only male plants were available. Later Diels amended the description (1922) by describing the female flowers, showing that this species, like several others of New Guinea, have an increased number of stigma and style parts (5). The stamen number in this species is five.

The leaves are oblong, linear-lanceolate, 4–12 cm. long, 1.5–3.2 cm. wide, very short or obtusely acuminate at the apex and rounded at the base, coriaceous, entire, rust-colored pubescent below, glabrous above, subsessile with hairy petiole 1.0–2.0 mm. long. Usually there is one, rarely two flowers in the axil. Tree ten meters high.

49. **Eurya meizophylla** (Diels), comb. nov.

Eurya tigang Schumann & Lauterbach var. *meizophylla* Diels in Bot. Jahrb. **57**: 434 (1922).

DISTRIBUTION: New Guinea.

NEW GUINEA: wooded mountains, Lordberg, Kaiser Wilhelm Land, alt. 1000 m., *C. Ledermann 9981* (type; photo. and fragment, AA) (slender tree 15–20 meters with brown bark, white flowers and dark green leaves).

The differences between this species and *E. tigang* are enough to warrant specific ranking. *Eurya meizophylla* has larger, oblique leaves, tapering considerably to a very fine apex, distinctly cuneate at the base and according to my specimen glabrous. *Eurya tigang,* on the other hand, has smaller leaves, although acuminate, bluntly so, quite rounded at the base and quite pubescent on the under surface. The veining of the latter is nearly at a right angle to the midrib while that in *E. meizophylla* is more nearly at a forty-five degree angle and is more sweeping.

The leaves are somewhat oblique, membranaceous, 10–13 cm. long, 3.5–4.5 cm. wide, gradually diminishing at the apex, a little hairy at the bud.

50. **Eurya leptantha** Diels in Bot. Jahrb. **57:** 433(1922).—Melchior in Engler & Prantl, Nat. Pflanzenfam. ed. 2, **21:** 148 (1925).

DISTRIBUTION: New Guinea.

NEW GUINEA: mountain forest, Schraderberg, Sepik-Terr., Kaiser Wilhelm Land, alt. 2070 m., *C. Ledermann 12201* (type; photo. and fragment, AA) (tree 8–10 m. with dark brown bark; leaves shiny, dark green, gray-green beneath; flowers white).

This species, studied only from the photograph and fragment of the type, is outstanding among the New Guinea euryas in that its leaves are distinctly membranous. It has five stamens and five styles, the latter joined (fide Diels) to the middle. The branchlets are lax, not firm and the leaves are lanceolate or lance-oblong (4.0–5.5 cm. long, 1.0–1.5 cm. broad), unequal at the base and long-acuminate at the apex.

51. **Eurya Rehderiana,** spec. nov.

Arborescens ramis teretibus glabris; foliis coriaceis glabris obovatis vel ellipticis 9–10 cm. longis et ca. 3 cm. latis subito acuminatis basi cuneatis margine revolutis integris apice acuminato serrato excepto, petiolis crassis 4–5 mm. longis; fructibus baccatis globosis 5–6 mm. longis et 4–5 mm. latis glabris, stylis brevissimis 5-fidis persistentibus, stigmatibus 5.

DISTRIBUTION: New Guinea.

NEW GUINEA. BRITISH NEW GUINEA: common in forests of lower slopes of Mt. Tafa, Central Division, alt. 2400 m., *L. J. Brass 5073* (type, AA), May-September 1933.

Slender tree 10–15 m. high. Branches terete, reddish-brown while young, grayish when older, glabrous. Leaves thick, coriaceous, glabrous even to bud, obovate to elliptic, 9–10 cm. long, approximately 3 cm. wide, abruptly acuminate at apex, emarginate, serrate at the tapering apex, entire otherwise; petiole stout, 3–5 mm. long. Fruit globose, numerous, dark purple, 5–6 mm. long, 4–5 mm. broad, borne singly or in clusters of 2–3 along the stem, pedicels up to 5 mm.

This new species resembles *Eurya phyllopoda* (Diels) in general form. However, it is separated from this New Guinean species by its entirely glabrous condition as contrasted to

the pubescent leaves and leaf-buds of the latter. Also *E. phyllopoda* is finely serrate along the whole leaf; *E. Rehderiana,* on the other hand, is serrate only at the acuminate apex. The apex of *E. phyllopoda* is acuminate and tapers to a very fine point while *E. Rehderiana* tapers less finely and is emarginate.

It is a pleasure to name this species in honor of Prof. Alfred Rehder, Curator of the Herbarium, Arnold Arboretum. Long a recognized authority on the ligneous flora of the Orient, his interest and helpful criticism in this study are gratefully appreciated.

52. **Eurya oxysepala** Diels in Bot. Jahrb. **57**: 435(1922).—Melchior in Engler & Prantl, Nat. Pflanzenfam. ed. 2, **21**: 148 (1925).

Distribution: New Guinea.

New Guinea. kaiser wilhelm land: Sepik Terr., Schraderberg, mountain forest, alt. 2070 m., *C. Ledermann 11971* (type; photo. and fragment, AA), June 13, 1913 (tree 15–20 m.; flowers white; leaves shiny dark green with bright red petioles, young leaves yellowish-red; bark gray-brown).

This species in general appearance resembles *E. Rehderiana.* However, it can be easily distinguished by its leaves which are ovate rather than obovate, less coriaceous, not revolute and serrate along the whole margin. Also the pedicels on the fruit are shorter.

The leaves of *E. oxysepala* are 6–13 cm. long and 2–4 cm. wide, shining dark green, yellowish-red when young. The petiole is bright red.

53. **Eurya phyllopoda** (Diels), comb. nov.

Eurya tigang K. Schumann & K. Lauterbach var. *phyllopoda* Diels in Bot. Jahrb. **57**: 435(1922).

Distribution: New Guinea.

New Guinea. kaiser wilhelm land: Sepik Terr., rocky-peak, forest, alt. 1400–1500 m., *C. Ledermann 12752* (type; photo. and fragment, AA), Aug. 19, 1913 (tree 10–12 m. with greenish-white flowers and blue-black fruit; leaves bright shining green, almost white [fide collector] underneath).

Diels in describing *E. tigang* var. *phyllopoda* felt it was, perhaps, only a mature form of *Eurya tigang.* The very leathery leaves, along with the elongated petiole and the tapering base of the leaf, are all outstanding characters in this genus and

merit specific distinction. This species is much nearer the newly described *Eurya Rehderiana* found in British New Guinea. *Eurya phyllopoda* has very finely serrate leaves and leaf-buds which are closely strigose-silky, while *E. Rehderiana* is very glabrous even to the leaf-bud and entire except for the acuminate portion at the apex of the leaf.

DOUBTFUL OR LITTLE-KNOWN SPECIES

Eurya boninensis Koidzumi in Bot. Mag. Tokyo, **32**: 253 (1918).

No material has been available for the study of this species. Koidzumi remarks that it is closely allied to *E. chinensis* f. *macrophylla* but can be distinguished easily, since it is entirely glabrous. Floral descriptions are omitted and the style remnant is considered an apiculate portion of the capsule. This species, because of its glabrous condition, its crenate-serrate leaves and its distribution, probably belongs to E. *japonica* or is a close relative.

Eurya castaneifolia Vesque in Bull. Soc. Bot. France, **42**: 158(1895).

This species was described from a very fragmentary specimen collected by Hooker & Thomson in Khasia and deposited in the Paris Museum. Vesque, in his description, says that the plant is entirely glabrous. This is difficult to believe. The photograph of the type which I have examined shows there are no terminal buds. The stem instead of being angled—a character which is usually associated with glabrous terminal buds—is quite terete. I am of the opinion that the terminal buds, were they present, would be pubescent. The only glabrous relative from Khasia would be *E. nitida* Korthals. However, from general observation, the fragment appears more closely related to pubescent *E. acuminata* DC.

Eurya grandis Choisy in Zollinger, Syst. Verz. Ind. Archip. 147(1854).—Mueller in Walpers, Ann. Bot. Syst. **4**: 347(1857).—Miquel, Fl. Nederl. Ind. **1**^{2}: 471(1859).—Koorders & Valeton, Bijdr. Boomsoorten Java, **3**: 246(1896).

Choisy, in his original description, states that *E. grandis* is

glabrous with terete branches and ovate-acuminate leaves. One would naturally place this species from this description under *E. glabra.* At the same time, however, Choisy remarks that the species is very closely related to *E. Blumeana, E. euprista* and *E. serrata,* all three synonyms of pubescent *E. acuminata.* Later Koorders & Valeton, although recognizing it as a valid species, mention that the species is pubescent. In this case the species in question might be united with *E. acuminata.*

Eurya muricata Dunn in Jour. Bot. **48**: 324(1910).

Doubt will hang over this species until the type can be located and studied. There is no record of *Dunn 877* (type) at Kew, and it has been suggested that the specimen may be in the herbarium of the Hongkong Botanical Garden. In the herbarium of the New York Botanical Garden is a supposed isotype. However, this specimen does not agree with the description of Dunn at all and one feels that probably there is an error in the label.

Eurya osimensis Masamune in Trans. Nat. Hist. Soc. Formosa, **25**: 249(1935).

The original description of this species is very inadequate. Leaf measurements were omitted and the author evidently had seen no flowers. The fruit was merely described as globose, a character which could apply to nearly all the species of *Eurya.*

Eurya rapensis F. Brown in Bernice P. Bishop Mus. Bull. no. **130**: 182, f. 26(1935).

My attention was drawn to this species very late in this study—too late in fact to obtain material. The author states that the species was collected on the island Rapa (southern Polynesia) and is closely "allied to *E. vitiensis* A. Gray from Fiji, from which it differs in the larger leaves [4–7 × 1–3 cm.], solitary flowers, 4–5-parted style, the presence of rudimentary stamens in the carpellate flowers and the larger fruits. Native name is *pooto* in Rapa."

Knowing how variable are the characters mentioned by Brown as limiting the species I am loath to accept or disregard the species until material can be had for study.

Eurya ryukyuensis Masamune in Trans. Nat. Hist. Soc. Formosa, **25**: 249(1935).

As in the case of *E. osimensis,* Masamune fails to give any outstanding characters in his description to separate the species from any number of other species of *Eurya.* He evidently lacked both staminate and pistillate flowers. The fruit, he describes, as axillary, very much like *E. japonica.* In fact, the whole description might well apply to *E. japonica.*

Eurya ternatana Miquel in Ann. Mus. Bot. Lugd.-Bat. **4**: 105 (1868–69).

Only a photograph of the type was available for study of the species. To draw any conclusions concerning this species was quite impossible, hence it must be placed here pending further study.

Eurya timorensis Zippel ex Spanoghe in Linnaea, **15**: 177 (1841), *nomen nudum.*

To my knowledge, the only citation of this species is the original. Spanoghe merely listed it and intimated that he had no knowledge of it.

Eurya yakushimensis (Makino) Makino in Bot. Mag. Tokyo, **27**: 72(1913).

Eurya japonica Thunberg var. *yakushimensis* Makino in Bot. Mag. Tokyo, **24**: 20(1910).

From the description, this species, first described by Makino as a variety and later raised to specific rank, seems nothing more than a narrow-leaved form of *E. japonica.* However, no authentic material has been available, hence the species must be placed here pending further study.

EXCLUDED SPECIES

Eurya albo-punctata (Grisebach) Melchior in Engler & Prantl, Nat. Pflanzenfam. ed. 2, **21**: 147(1925). = **Ternstroemia albo-punctata** Grisebach.

Eurya angulosa (Tulasne) Szyszylowicz in Engler & Prantl, Nat. Pflanzenfam. III. **6**: 190(1893). = **Freziera angulosa** Tulasne.

Eurya arbutifolia (Triana & Planchon) Szyszylowicz in Engler & Prantl, Nat. Pflanzenfam. III. **6**: 190(1893). = **Freziera arbutifolia** Triana & Planchon.

Eurya Benthamiana (Bentham) Bullock in Kew Bull. Misc. Inform. **1936**: 391 (1936). = **Freziera integrifolia** Bentham, non *E. integrifolia* Blume.

Eurya boliviensis (Wawra) Szyszylowicz in Engler & Prantl, Nat. Pflanzenfam. III. 6: 190(1893). = **Freziera boliviensis** Wawra.

Eurya Bolleana O. C. Schmidt in Fedde, Rep. Spec. Nov. **33**: 177(1933). = **Freziera Bolleana** (O. C. Schmidt), comb. nov.

Eurya calophylla (Triana & Planchon) Szyszylowicz in Engler & Prantl, Nat. Pflanzenfam. III. 6: 190(1893). = **Freziera calophylla** Triana & Planchon.

Eurya candicans (Tulasne) Szyszylowicz in Engler & Prantl, Nat. Pflanzenfam. III. 6: 190(1893). = **Freziera candicans** Tulasne.

Eurya Cavaleriei Léveillé in Fedde, Rep. Spec. Nov. **9**: 450(1911). = **Symplocos laurina** (Retzius) Wallich.

Eurya cernua (Tulasne) Szyszylowicz in Engler & Prantl, Nat. Pflanzenfam. III. 6: 190(1893). = **Freziera cernua** Tulasne.

Eurya conocarpa O. C. Schmidt in Fedde, Rep. Spec. Nov. **22**: 98(1925). = **Freziera conocarpa** (O. C. Schmidt), comb. nov.

Eurya cordata (Tulasne) Szyszylowicz in Engler & Prantl, Nat. Pflanzenfam. III. 6: 190(1893). = **Freziera cordata** Tulasne.

Eurya Dombeyana (Tulasne) Szyszylowicz in Engler & Prantl, Nat. Pflanzenfam. III. 6: 190(1893). = **Freziera Dombeyana** Tulasne.

Eurya Ekmani O. C. Schmidt in Fedde, Rep. Spec. Nov. **22**: 97(1925). = **Freziera Ekmani** (O. C. Schmidt), comb. nov.

Eurya Esquirolii Léveillé, Fl. Kouy-Tchéou, 415(1915) *nomen nudum*. = **Litsea Kobuskiana** Allen.

Eurya ferruginea (Wawra) Szyszylowicz in Engler & Prantl, Nat. Pflanzenfam. III. 6: 190(1893). = **Freziera ferruginea** Wawra.

Eurya Friedrichsthaliana Szyszylowicz in Engler & Prantl, Nat. Pflanzenfam. III. 6: 190(1893). = **Freziera Friedrichsthaliana** (Szyszylowicz), comb. nov.

Eurya Grisebachii (Krug & Urban) Melchior in Engler & Prantl, Nat. Pflanzenfam. ed. 2, **21**: 148(1925). = **Freziera Grisebachii** Krug & Urban.

Eurya guatemalensis Donnell-Smith in Bot. Gaz. **46**: 109(1908). = **Freziera guatemalensis** (Donnell-Smith), comb. nov.

Eurya guianensis (Wawra) Szyszylowicz in Engler & Prantl, Nat. Pflanzenfam. III. 6: 190(1893). = **Frieziera guianensis** Wawra.

Eurya Hintoni Bullock in Kew Bull. Misc. Inform. **1936**: 391(1936). = **Symplocarpon Hintoni** (Bullock) Airy-Shaw in Hooker's Icon. Pl. **4**: t. 3342(1937).

Eurya inaequalifolia Lingelsheim in Fedde, Rep. Spec. Nov. **7**: 111(1909). = **Freziera inaequalifolia** (Lingelsheim), comb. nov.

Eurya inaequilatera (Britton) Melchior in Engler & Prantl, Nat. Pflanzenfam. ed. 2, **21**: 149(1925). = **Freziera inaequilatera** Britton.

Eurya Karsteniana Szyszylowicz in Engler & Prantl, Nat. Pflanzenfam. III. 6: 190(1893). = **Freziera Karsteniana** (Szyszylowicz), comb. nov.

Eurya lanata (Tulasne) Melchior in Engler & Prantl, Nat. Pflanzenfam. ed. 2, **21**: 149(1925). = **Freziera lanata** Tulasne.

Eurya lancifolia Standley in Field Mus. Publ. Bot. **8**: 317(1931). = **Freziera lancifolia** (Standley), comb. nov.

Eurya lasiopetala (Wight) Gardner in Calcutta Jour. Nat. Hist. **7**: 446(1847) = **Adinandra lasiopetala** (Wight) Choisy.

Eurya Lehmannii Hieronymus in Bot. Jahrb. **20**, Beibl. 49: 49(1895). = **Freziera Lehmannii** (Hieronymus), comb. nov.

Eurya longipes (Tulasne) Szyszylowicz in Engler & Prantl, Nat. Pflanzenfam. III. **6**: 190(1893). = **Freziera longipes** Tulasne.

Eurya macrophylla (Tulasne) Szyszylowicz in Engler & Prantl, Nat. Pflanzenfam. III. **6**: 190(1893). = **Freziera macrophylla** Tulasne.

Eurya mexicana (Turczaninow) Szyszylowicz in Engler & Prantl, Nat. Pflanzenfam. III. **6**: 189(1893). = **Freziera mexicana** (Turczaninow), comb. nov.

Eurya monsonensis Melchior in Engler & Prantl, Nat. Pflanzenfam. ed. 2, **21**: 149(1925). = **Freziera monsonensis** (Melchior), comb. nov.

Eurya myrtilloides Elmer, Leafl. Philipp. Bot. **1**: 323(1908). = **Ilex crenata** Thunberg var. **luzonica** (Rolfe) Loesener.

Eurya Nimanimae (Tulasne) Melchior in Engler & Prantl, Nat. Pflanzenfam. ed. 2, **21**: 147(1925). = **Freziera Nimanimae** Tulasne.

Eurya nitida Hieronymus in Bot. Jahrb. **20**, Beibl. 49: 50(1895), non Korthals. = **Freziera Hieronyma,** nom. nov.

Eurya reticulata (Humboldt & Bonpland) Szyszylowicz in Engler & Prantl, Nat. Pflanzenfam. III. **6**: 190(1893). = **Freziera reticulata** Humboldt & Bonpland.

Eurya reticulata (Humboldt & Bonpland) Szyszylowicz var. *subintegrifolia* Hieronymus in Bot. Jahrb. **20**, Beibl. 49: 51(1895). = **Freziera reticulata** Humboldt & Bonpland var. **subintegrifolia** (Hieronymus), comb. nov.

Eurya roraimensis (Tulasne) Szyszylowicz in Engler & Prantl, Nat. Pflanzenfam. III. **6**: 190(1893). = **Freziera roraimensis** Tulasne.

Eurya Seemanniana Pittier in Contrib. U. S. Nat. Herb. **20**: 480(1922). = **Freziera Seemanniana** (Pittier), comb. nov.

Eurya sericea (Humboldt & Bonpland) Szyszylowicz in Engler & Prantl, Nat. Pflanzenfam. III. **6**: 190(1893). = **Freziera sericea** Humboldt & Bonpland.

Eurya sericea (Humboldt & Bonpland) Szyszylowicz var. *chrysophylla* (Humboldt & Bonpland) Hieronymus in Bot. Jahrb. **20**, Beibl. 49: 49(1895). = **Freziera sericea** Humboldt & Bonpland var. **chrysophylla** (Humboldt & Bonpland), comb. nov.

Eurya spathulifolia Melchior in Engler & Prantl, Nat. Pflanzenfam. ed. 2, **21**: 149(1925). = **Freziera spathulifolia** (Melchior), comb. nov.

Eurya suberosa (Tulasne) Szyszylowicz in Engler & Prantl, Nat. Pflanzenfam. III. **6**: 190(1893). = **Freziera suberosa** Tulasne.

Eurya subintegrifolia (Rusby) Melchior in Engler & Prantl, Nat. Pflanzenfam. ed. 2, **21**: 149(1925). = **Freziera subintegrifolia** (Rusby), comb. nov.

Eurya syphilitica (Choisy) Szyszylowicz in Engler & Prantl, Nat. Pflanzenfam. III. **6**: 189(1893). = **Ternstroemia ?** sp.

Eurya ternstroemioides O. C. Schmidt in Fedde, Rep. Spec. Nov. **24**: 79(1927). = **Freziera ternstroemioides** (O. C. Schmidt), comb. nov.

Eurya vaccinioides O. C. Schmidt in Fedde, Rep. Spec. Nov. **22**: 98(1925). = **Freziera vaccinioides** (O. C. Schmidt), comb. nov.

Eurya verrucosa Hieronymus in Bot. Jahrb. **20**, Beibl. 49: 51(1895). = **Freziera verrucosa** (Hieronymus), comb. nov.

Eurya Wawrai (Urban) Melchior in Engler & Prantl, Nat. Pflanzenfam. ed. 2, **21**: 149(1925). = **Freziera Wawrai** Urban.

Eurya Yungasiae (Tulasne) Szyszylowicz in Engler & Prantl, Nat. Pflanzenfam. III. **6**: 190(1893). = **Freziera Yungasiae** Tulasne.

INDEX

Synonyms are printed in *italics;* new names in **bold-face** type.

STUDIES IN THE LAURACEAE. I[1]

Chinese and Indo-Chinese Species of Litsea, Neolitsea, and Actinodaphne

CAROLINE K. ALLEN

Assistant in the Herbarium, Arnold Arboretum of Harvard University

For many years there has been a great deal of confusion among taxonomists regarding the treatment of the genera of the Lauraceae. The line of demarcation between some of the genera is so artificial as to be useless in grouping the species together as natural units. The present treatment is no exception as far as this point is concerned. Its scope is merely to place the various species, in so far as is possible at this time, in the genera into which they fall according to the artificial key given below. Inasmuch as only Chinese and Indo-Chinese material is considered, the key will hold. The study of the Indian species, which I hope to make eventually, will in all probability necessitate many more transfers, or perhaps even a revision of our concepts of the genera involved. Because this study is limited geographically, the sections which have been described will not be taken up at present. These will be treated at a later date.

In order to prevent any misunderstanding of terms, there are a few definitions which I deem it advisable to present.

By "triplinerved," I mean that situation in which the midrib and the lowermost pair of nerves are three distinct entities, adnate 1–20 (or more) mm. above the base of the leaf.

The term "minutely reticulate" refers to that type of reticulation which approaches a subfoveolate condition.

In treating the Lauraceae the term "umbellate" has been very loosely applied to the inflorescence. There are no true umbels in this family. It should be understood that in the following pages, where the term "umbel" or "umbellate" is used, the actual condition is one approaching that. "Subumbel" and "subumbellate" rather should be used.

[1] Issued December 27, 1937.

An "induvium" such as is found in *Litsea baviensis (L. Maclurei)* and *L. Pierrei* is, according to B. D. Jackson's 'Glossary,' that portion of the corolla which persists in a withered condition at the base of the fruit. The interpretation of Gatin is the one used in the following pages, namely, an accrescent calyx or perianth which enlarges to almost completely enclose the fruit.

It is my great pleasure to dedicate this paper to Dr. J. M. Greenman, of the Missouri Botanical Garden, to whom I owe inspiration and encouragement as a student in Botany. For the co-operation in preparing it, I am indeed grateful to Dr. E. D. Merrill, Director, and Prof. Alfred Rehder, Curator, of the Arnold Arboretum. Thanks are due also to the curators of the herbaria of the following institutions for the generous loan of types and photographs of types: University of California, Gray Herbarium of Harvard University, Royal Botanical Gardens at Kew, Rijksherbarium at Leiden, New York Botanical Garden, Muséum National d'Histoire Naturelle at Paris, and Botanisches Institut der Universität at Vienna.

KEY TO THE GENERA

1. Fertile stamens 12; leaves usually penninerved.
   2. Bracts persistent until anthesis; fruits subtended by unchanged calyx tube, or one thickened or discoid; leaves usually non-verticillate........ ....*Litsea*, p. 362
   2. Bracts caducous before anthesis; fruit subtended by cyathiform calyx tube appendaged by residue of lobes; leaves usually verticillate........ ....*Actinodaphne*, p. 400
1. Fertile stamens 6; leaves 3-plinerved (usually) ....*Neolitsea*, p. 415

KEY TO THE SPECIES OF LITSEA

1. Leaves membranaceous and usually deciduous.
   2. Leaves orbicular or broadly ovate; petioles 3–5 cm. long.
      3. Leaves auriculate at base..............................1. *L. auriculata*
      3. Leaves not auriculate at base..........................2. *L. populifolia*
   2. Leaves not orbicular or broadly ovate; petioles less than 2 cm. long.
      3. Flowers 4–6 per umbel.
         4. Lower leaf-surface very softly pubescent; bark with turpentine-like odor...3. *L. mollifolia*
         4. Lower leaf-surface glabrous to somewhat pubescent; bark aromatic, not with turpentine odor.

5. Fruit globose, apiculate .... 4. *L. euosma*
5. Fruit spherical, with no pronounced apicule .... 5. *L. Cubeba*
3. Flowers 7–12 (or more) per umbel.
4. Peduncles of inflorescence 1.5–3.5 cm. long .... 6. *L. Forrestii*
4. Peduncles of inflorescence less than 1.5 cm. long.
5. Young leaves covered with long yellowish or reddish brown sericeous pubescence.
6. Leaves oblong-lanceolate, acuminate .... 7. *L. sericea*
6. Leaves obovate-elliptic, acute or obtuse, pubescence conspicuously persisting along midrib at maturity .... 8. *L. Veitchiana*
5. Young leaves not covered with long yellowish or reddish brown sericeous pubescence.
6. Branchlets very long and seemingly pendulous, with very short floriferous side shoots .... 9. *L. moupinensis*
6. Branchlets not very long and not seemingly pendulous; numerous side branchlets up to 15 cm. long.
7. Flowers in anthesis before the appearance of leaves.
8. Leaves pubescent to glabrescent; fruit slightly more ellipsoid than globose .... 10. *L. pungens*
8. Leaves glabrous; fruit globose .... 11. *L. ichangensis*
7. Flowers in anthesis after the appearance of leaves.
8. Leaves obovate-oblong or elliptic-oblong .... 12. *L. Chenii*
8. Leaves not obovate-oblong or elliptic-oblong.
9. Leaves less than 4.7 cm. long .... 13. *L. Chunii*
9. Leaves always more than 4 cm. long.
10. Leaves 4–6 cm. long .... 14. *L. rubescens*
10. Leaves longer than 4–6 cm.
11. Leaves somewhat rounded; pedicels 7–8 mm. long .... 14a. *L. rubescens* var. *yunnanensis*
11. Leaves 12–13 cm.; pedicels 9–10 mm. long .... 14b. *L. rubescens* f. *tonkinensis*
1. Leaves not membranaceous and not deciduous as far as is known.
2. Leaves verticillate.
3. Leaves acutish or obtuse at base.
4. Leaves closely pubescent, margin never appearing ciliate; ultimate venation fine but not reticulate; umbels 5 mm. in diam......... .... 15. *L. verticillata*
4. Leaves loosely covered with long rather silky pubescence, margin appearing ciliate; ultimate venation very loose; umbels 8 mm. in diam. .... 15a. *L. verticillata* var. *annamensis*
3. Leaves rounded or subauriculate at base.
4. Fruit subsessile or very short-pedunculate .... 15b. *L. verticillata* var. *brevipes*
4. Fruit decidedly long-pedunculate...15c. *L. verticillata* var. *brevipetiolata*
2. Leaves not verticillate.
3. Leaves heavily coriaceous; mostly over 12 cm. long.
4. Inflorescence subumbellate.
5. Leaves obovate .... 16. *L. honghoensis*

5. Leaves not obovate.
  6. Leaves over 25 cm. long........................17. *L. grandifolia*
  6. Leaves not over 22 cm.
    7. Inflorescence subsessile or very short-pedunculate.
      8. Leaves finely and pale-tomentose on lower surface, ferrugineous-tomentose on veins; fruit subtended by pubescent cupule not over 0.5 cm. deep...18. *L. Griffithii* var. *annamensis*
      8. Leaves glabrous or subglabrous on lower surface.
        9. Fruit subtended by shallow cupule 3–5 mm. deep, and 7 cm. broad, cupule sessile..................19. *L. Clemensii*
        9. Fruit subtended by large verrucose cupule 2 cm. deep and 2 cm. broad, cupule pedunculate............20. *L. baviensis*
    7. Inflorescence definitely pedunculate.
      8. Leaves lanceolate or lanceolate-elliptic.
        9. Leaves subtriplinerved..21a. *L. chartacea* var. *subtriplinervis*
        9. Leaves penninerved.
          10. Secondary veins 6–8 pairs at most, very dark against the glaucous lower surface of the leaf; leaves lanceolate-elliptic........................21. *L. chartacea*
          10. Secondary veins more than 10 pairs......22. *L. lancilimba*
      8. Leaves elliptic or oblong-elliptic.
        9. Largest leaves not under 15 cm...............23. *L. longipes*
        9. Largest leaves not over 13 cm.
          10. Lateral veins prominent below, nearly as prominent as midribs.................24. *L. Helferi* var. *laosensis*
          10. Lateral veins obsolete or subobsolete; midrib very prominent........................25. *L. eugenioides*
4. Inflorescence not subumbellate.
  5. Largest leaves not less than 16 cm. long.
    6. Largest leaves 23–25 cm. long........29a. *L. Pierrei* var. *grandifolia*
    6. Largest leaves 16–20 cm. long.
      7. Perianth 8-parted.............................26. *L. Liyuyingi*
      7. Perianth 6-parted.
        8. Inflorescence subtended by pedicels 4–5 mm. long, leaves oblanceolate.................20a. *L. baviensis* var. *szemaoïs*
        8. Inflorescence subtended by pedicels 2 mm. long, leaves elliptic...................................27. *L. Panamonja*
  5. Largest leaves not more than 15 cm. long.
    6. Fruit globose ....28. *L. Rehderiana*
    6. Fruit not globose.
      7. Inflorescence subtended by pedicels about 2 mm. long; fruit ellipsoid, 25 × 10–11 mm.; cupule never lobed......29. *L. Pierrei*
      7a. Fruit ellipsoid-ovoid, 22 × 11–12 mm.; cupule often lobed ....29b. *L. Pierrei* var. *lobata*
      7. Inflorescence subtended by pedicels 5–12 mm. long; leaves up to 15 cm. long............................30. *L. cambodiana*
      7a. Common peduncle 4 cm. long; leaves up to 10 cm. long.... ....30b. *L. cambodiana* var. *multiracemosa*

7b. Common peduncle 10 cm. long; leaves variable.......... ....30a. *L. cambodiana* var. *longiracemosa*

3. Leaves subcoriaceous; mostly less than 12 cm. long.
4. Leaves linear to linear lanceolate.
5. Inflorescence sessile...............................31. *L. Thorelii*
5. Inflorescence definitely pedunculate............32. *L. pseudoelongata*
4. Leaves not linear to linear-lanceolate.
5. Perianth incomplete or aborted; leaves, pedicels and branchlets heavily pubescent................................33. *L. glutinosa*
5a. Leaves smaller, and always obtuse..................... ....33a. *L. glutinosa* var. *brideliifolia*
5. Perianth complete, 6 segments.
6. Leaves rotund to ovate to obovate or obovate-elliptic.
7. Leaves rotund, less than 4 cm. long............34. *L. rotundifolia*
7. Leaves not rotund, more than 4 cm. long.
8. Leaves obtuse or rounded at apex, occasionally short-acuminate or apiculate.
9. Leaves shining above, oval-oblong; petioles 1–1.5 cm. long ....35. *L. firma* var. *austrannamensis*
9. Leaves dull above, obovate or obovate-oblong; petioles 1–2.4 cm. long........................36. *L. monopetala*
8. Leaves acuminate at apex, acute at base.
9. Largest leaves under 11 cm. long.............37. *L. Wilsonii*
9. Largest leaves over 11 or usually 15 cm. long.
10. Stamens not exserted; leaves very attenuately acuminate, tending towards caudate, slightly falcate.... ....38. *L. Garrettii*
10. Stamens greatly exserted........................ ....38a. *L. Garrettii* var. *longistaminata*
6. Leaves not rotund to ovate to obovate or obovate-elliptic.
7. Inflorescences crowded at the tips of branches.
8. Lateral veins ascending, mostly prominent (except in *L. Kobuskiana*).
9. Umbels subsessile or short-pedunculate; peduncles 2–3 mm. long.
10. Bracts on outer surface canescent-sericeous at apex, shading to brown-pubescent at base.
11. Lateral veins very prominent; leaves obovate, pubescent below........................39. *L. acutivena*
11. Lateral veins obscure; leaves oblong-elliptic or lanceolate, glabrescent to glabrous......40. *L. Kobuskiana*
10. Bracts pale brownish-pubescent............41. *L. Faberi*
9. Umbels pedunculate; peduncles 4–5 cm. long.
10. Leaves pubescent on lower surface........42. *L. elongata*
10. Leaves glabrous or extremely glabrescent on lower surface...............42a. *L. elongata* var. *cuneifolia*
8. Lateral veins not ascending, but nearly horizontal, very obscure; leaves glaucous on lower surface......43. *L. hupehana*

7. Inflorescences not crowded at the tips of branches.
 8. Leaves 15 cm. or more long.
  9. Stamens very greatly exserted; leaves greyish-brown, pubescent on lower surface .... 44. *L. Dunniana*
  9. Stamens not exserted.
   10. Leaves and branchlets ferrugineous-pubescent .... 45. *L. mekongensis*
   10. Leaves and branchlets glabrous to glabrescent .... 46a. *L. viridis* var. *Clemensii*
 8. Leaves less than 12 cm. long.
  9. Inner pairs of bracts cano-sericeous; outer brown-pubescent; leaves very pale green .... 46. *L. viridis*
  9. Inner pairs of bracts not differentiated from outer.
   10. Leaves oblong-linear, narrowly or oblong-lanceolate; secondary venation obscure above; inflorescence short-racemose .... 47. *L. iteodaphne*
    10a. Leaves subacuminate; venation inconspicuous .... 47a. *L. iteodaphne* f. *chinensis*
   10. Leaves not oblong-linear or oblong-lanceolate.
    11. Leaves oblanceolate, obtuse.
     12. Leaves usually less than 7 cm. long, glaucous and obscurely reticulate below .... 34a. *L. rotundifolia* var. *oblongifolia*
     12. Leaves more than 7 cm. long, variable in shape, not glaucous, but conspicuously reticulate below .... 48. *L. variabilis*
    11. Leaves lanceolate or elliptic.
     12. Leaves somewhat membranaceous, glaucous .... 48a. *L. variabilis* var. *oblonga*
     12. Leaves more coarse, less membranaceous.
      13. Leaves glabrous below .... 49. *L. Greenmaniana*
      13. Leaves pubescent below.
       14. Veins 6 or less pairs.
        15. Leaves greyish-glaucous or lightly pubescent below; brownish-pubescent on veins .... 50. *L. lancifolia*
         15a. Umbels pedunculate; peduncles 5–6 mm. long ..... 50a. *L. lancifolia* var. *pedicellata*
        15. Leaves not glaucous-pubescent below; pubescent on nerves at first, finally glabrous .... 51. *L. Balansae*
       14. Veins more than 6 pairs; leaves and branchlets brown-tomentose below .... 52. *L. umbellata*

1. **Litsea auriculata** Chien & Cheng, Contr. Biol. Lab. Sci. Soc. China, 6: 59, fig. 1. 1931.

Distribution: known only from type locality.

CHINA. CHEKIANG: *S. S. Chien 601; W. C. Cheng 2348, 2349* (syntypes, Herb. Biol. Lab. Sci. Soc.; isotypes, AA); *S. Chen 518; W. C. Cheng 2152.*

A large-leaved *Litsea* with the auriculate-obovate leaves 17 × 13 cm. approximately, presenting an unmistakable diagnostic character. The most nearly related species is *Litsea cordata* Jack, from India, which is readily distinguished by its long-racemose inflorescence. *Litsea auriculata* Chien & Cheng resembles also *Actinodaphne confertiflora* Meissn. from India and from western China, which does not have auriculate leaf-bases and is minutely reticulate on both leaf-surfaces.

2. **Litsea populifolia** (Hemsl.) Gamble in Sargent, Pl. Wilson. **2**: 77. 1914; Liou, Laurac. Chine Indoch. 172. 1932.

Lindera obovata Franch. Nouv. Arch. Mus. Hist. Nat. Paris, sér. II. **10**: 76. 1887; Pl. David. **2**: 114. 1888.

Lindera populifolia Hemsl. Jour. Linn. Soc. Bot. **26**: 390. 1891.

Litsea longipetiolata Lecomte, Bull. Soc. Bot. France, **60**: 85. 1913; Nouv. Arch. Mus. Hist. Nat. Paris, sér. V. **5**: 88. 1913; Liou, Laurac. Chine Indoch. 172. 1932, **syn. nov.**

Benzoin obovatum (Franch.) Rehd. Jour. Arnold Arb. **1**: 145. 1919; Chun, Contr. Biol. Lab. Sci. Soc. China, **1**[5]: 42. 1925.

DISTRIBUTION: Tibet and western China.

TIBET. MOUPIN: *A. David* (type of *Lindera obovata* and syntype of *Litsea longipetiolata* not seen, Paris).

CHINA. YUNNAN: *J. M. Delavay 188, 5163* (syntypes of *Litsea longipetiolata*, Paris); *F. Ducloux 2110* (syntype of *L. longipetiolata*, Paris); *H. T. Tsai 51120, 52272.*—SZECHUAN: *E. Faber 55* (type of *Lindera populifolia*, Kew; isotype, NY); *F. T. Wang 22758; T. T. Yü 509, 534; W. P. Fang 2153, 2399.*

This species is characterized by large, up to 10 cm., orbicular or obovate leaves which have very long, up to 6 cm., slender petioles. Lecomte, in making the new combination under *Litsea*, proposed a new name since Nees had already published a *Litsea obovata* in reference to an entirely different plant. The differences between the types of *Litsea longipetiolata* and *L. populifolia* represent a degree of variation among individuals of the same species. There seems to be no valid character which separates the two.

3. **Litsea mollifolia** Chun, Sunyatsenia **1**: 236. 1934.

Litsea mollis Hemsl. Jour. Linn. Soc. Bot. **26**: 383. 1891; Chun, Contr. Biol. Lab. Sci. Soc. China, **1**[5]: 60. 1925; Liou, Laurac. Chine Indoch. 186. 1932; non *Litsea mollis* (Bl.) Boerl. in Handl. Fl. Ned. Ind. **3**: 141. 1900.

DISTRIBUTION: western and central China.

CHINA. HUPEH: *A. Henry 3177, 4434, 5035* (syntypes, Kew; isotypes, AA), *1026* (syntype not seen, Kew); *C. S. Fan & Y. Y. Li 187.*—KWEICHOW: *A. N. Steward, C. Y. Chiao & H. C. Cheo 349.*

The species is difficult to separate from *L. Cubeba* Pers. and *L. euosma* W. W. Sm. For complete discussion see the latter species.

4. **Litsea euosma** W. W. Sm. Notes Bot. Gard. Edinb. **13**: 166. 1921; Liou, Laurac. Chine Indoch. 187. 1932.

DISTRIBUTION: French Indo-China, Burma and western China.

CHINA. YUNNAN: *G. Forrest 9333, 7858, 15951* (syntypes, Edinburgh; isotypes, AA); *G. Forrest 12101, 17947* (syntypes not seen, Edinburgh); *J. F. Rock 7361, 7736; H. T. Tsai 54981, 56672, 56782.*

FRENCH INDO-CHINA. TONKIN: *E. Poilane 19135.*

A species very difficult to separate from *Litsea mollifolia* Chun and *L. Cubeba* Pers. The fruit of *Litsea euosma* W. W. Sm. is definitely globose apiculate, and the bark (according to the original description, and some of the dried specimens still retain it) has a lemon-like fragrance. The fruit of *L. Cubeba* is spherical, with no pronounced apicule, and the bark is reported to be aromatic, hence the name *L. citrata* Bl. applied to the specimen from Java. The type specimens of *L. mollifolia* have a turpentine-like odor; the fruit is subglobose with no apparent apicule; the leaves seem to be less attenuately acuminate at the apex than those of *L. euosma. Litsea Cubeba* is glabrous to glabrescent; *L. euosma* is somewhat pubescent; and *L. mollifolia* extremely softly pubescent. As for distribution, *Litsea Cubeba* is widespread in southern Asia and the adjacent islands. *Litsea euosma* is prevalent in western China, Siam, and Burma. *Litsea mollifolia* is found in central and western China, and possibly in the east-central provinces.

5. **Litsea Cubeba** (Lour.) Pers. Syn. **2**: 4. 1807; Chun, Contr. Biol. Lab. Sci. Soc. China, 1^5: 57. 1925; Rehd. Jour. Arnold. Arb. **11**: 157. 1930; Liou, Laurac. Chine Indoch. 184. 1932; Merr. Trans. Am. Philos. Soc. n. ser. **24**: 166 (Comm. Loureiro Fl. Cochinch.). 1935.

Laurus Cubeba Lour. Fl. Cochinch. 1: 252. 1790; ed. 2, 310. 1793.

Litsea citrata Bl. Bijdr. 565. 1825; Hemsl. Jour. Linn. Soc. Bot. **26**: 379. 1891.

Litsea mollis Hemsl. var. *glabrata* Diels, Engler's Bot. Jahrb. **29**: 349. 1900.

Litsea mollifolia Chun var. *glabrata* (Diels) Chun, Sunyatsenia, **1**: 237. 1934, **syn. nov.**

For complete synonomy see Rehder, l.c.

DISTRIBUTION: India to China and Malaysia.

FRENCH INDO-CHINA. TONKIN: *J. Loureiro* (type not seen, Brit. Mus.); *A. Petelot 5569.*

CHINA. SZECHUAN: *F. T. Wang 22493, 23341; W. P. Fang 1069, 1199, 2186, 2213, 3065.*—YUNNAN: *A. Henry 11326, 11395, 12838; H. T. Tsai 50894, 51202, 51329, 51438, 51530, 51668, 51807, 54264, 55122, 55201, 55377, 58872, 59035, 59643, 59741, 60013, 60593, 62118.*—KWANGSI: *W. T. Tsang 22903, 21183, 21535, 21768; A. N. Steward & H. C. Cheo 2, 847, 727, 535.*—FUKIEN: *J. L. Gressitt 1716.*—KIANGSI: *S. K. Lau 4461, 3992.*—HAINAN: *F. C. How 70830, 71773; W. T. Tsang 187, 838; N. K. Chun & C. L. Tso 43730; C. Wang 33336, 34881, 35380; H. Y. Liang 63461, 64180, 64315, 64717, 66059.*

Many specimens more were seen but only a few of the numbers are cited above.

An extremely variable well-known species which is widespread, occurring throughout southern Asia and as far south as Java. It is often confused with *Litsea euosma* W. W. Sm. and *L. mollifolia* Chun. A detailed discussion is given under *L. euosma* W. W. Sm.

6. **Litsea Forrestii** Diels, Notes Bot. Gard. Edinb. **5**: 244. 1912; Liou, Laurac. Chine Indoch. 163. 1932.

DISTRIBUTION: western China.

CHINA. YUNNAN: *G. Forrest 374* (type not seen, Edinburgh).

Litsea Forrestii was described from immature specimens. Diels states that the species is easily recognized by the long peduncles of the inflorescence. The following numbers with these characteristically long peduncles are cited as possibly belonging to this species: from Yunnan, *J. F. Rock 8036, 8126; C. Schneider 4022;* from Kweichow, *J. Esquirol 738*[1]; from Kwangsi, *A. N. Steward & H. C. Cheo 12.*

7. **Litsea sericea** (Nees) Hook. f. Fl. Brit. Ind. **5**: 156. 1886; Chun, Contr. Biol. Sci. Soc. China, **1**^{5}: 60. 1925; Liou, Laurac. Chine Indoch. 186. 1932.

Tetranthera sericea Nees in Wall. Pl. As. Rar. **2**: 67. 1831.

[1] **Litsea** spec. Allen, Jour. Arnold Arb. **17**: 330. 1936.

Lindera Esquirolii Lévl. Fedde, Rep. Spec. Nov. **9**: 327. 1911; Fl. Kouy-Tchéou, 219. 1914, as synonym of *Lindera praecox* Bl.

Distribution: India and western China.
India. nepal: *N. Wallich 2545A*[1] (isotype, Kew, NY).
China. szechuan: *T. T. Yü 489.*

A species often confused with *Lindera umbellata* Thunb. in the fruiting stage, but distinguished by the glabrous or nearly glabrous winter buds; the more chartaceous leaves finely but distinctly reticulate below, less so above; and by the smaller fruits only 4–5 mm. long, borne on very slender pedicels.

8. **Litsea Veitchiana** Gamble in Sargent, Pl. Wilson. **2**: 76. 1914; Chun, Contr. Biol. Lab. Sci. Soc. China, **1**[5]: 59. 1925; Liou, Laurac. Chine Indoch. 182. 1932.

Distribution: western China.
China. szechuan: *Veitch Exped. 4426; E. H. Wilson 3672* (syntypes, AA).

It is my opinion that the two specimens cited above are not conspecific. The color of the pubescence is different. *No. 4426* has long ferrugineous pubescence; *no. 3672* has light tawny pubescence. The veins of *no. 3672* are straight, evenly pinnate, those of *no. 4426* are crooked and irregularly pinnate. The leaf shape in general of *no. 3672* is the more lanceolate of the two. Liou has seen a ♂ specimen that is a satisfactory match *(Chen no. 5839)* for the species. He does not mention leaf characters in his description, so it is not clear which of the syntypes the latter matches. Until more abundant material comes in from Yunnan, I will merely call attention to the apparent dissimilarity between the two specimens cited as types.

9. **Litsea moupinensis** Lecomte, Bull. Soc. Bot. France, **60**: 84. 1913; Nouv. Arch. Mus. Hist. Nat. Paris, sér. V. **5**: 88. 1913; Liou, Laurac. Chine Indoch. 187. 1932.

Lindera puberula Franch. Pl. David. **2**: 115. 1887; Nouv. Arch. Mus. Hist. Nat. Paris. sér. II. **10**: 77. 1887.

Benzoin puberulum (Franch.) Rehd. Jour. Arnold Arb. **1**: 145. 1919; Chun, Contr. Biol. Lab. Sci. Soc. China, **1**[5]: 41. 1925.

Distribution: Tibet and western China.
Tibet. moupin: *A. David* in 1869 (type, Paris).
China. yunnan: *F. Ducloux 4508; P. Farges 617* (syntypes not seen, Paris).

[1] I have not seen any of the Wallich specimens which are the types of Nees' species treated in the present paper. However, I have borrowed the isotypes from Kew. At the death of Nees, the latter's herbarium was divided and sold. The Laurineae became a part of the Zschok herbarium which at that time was somewhere in Austria.

Franchet states that *Lindera puberula* Franch. is similar to *Lindera Griffithii* Meissn. and *Lindera sericea* Bl., differing, however, in the adult branches being covered with a very fine close pubescence. This is another case where it is practically impossible to match the ♂ and ♀ specimens. It is my belief that some of the fruiting specimens of *Lindera umbellata* Thunb., reported from Yunnan and Szechuan, are not linderas but belong to *Litsea moupinensis* Lecomte. I have seen in no collection from the western provinces of China a ♂ specimen of *Lindera umbellata.* Plenty have been collected from Japan and from eastern and even northern China. This discrepancy must eventually be accounted for, and it may be that the above suggestion will be the solution. When Lecomte recognized the above plant as a *Litsea,* he had to adopt a new name because of the earlier *Litsea puberula* Miq.

10. **Litsea pungens** Hemsl. Jour. Linn. Soc. Bot. **26**: 384. 1891; Gamble in Sargent, Pl. Wilson. **2**: 76. 1914; Chun, Contr. Biol. Lab. Sci. Soc. China, **1**^{5}: 59. 1925; Liou, Laurac. Chine Indoch. 186. 1932.

DISTRIBUTION: western and central China.

CHINA. HUPEH: *A. Henry 230, 1302* (syntypes not seen, Kew), *3617, 3617B, 6294* (syntypes, Kew; isotypes, Gray); *H. C. Chow 372, 583.*—SZECHUAN: *A. Henry 5579* (syntype not seen, Kew).—KWEICHOW: *A. N. Steward, C. Y. Chiao & H. C. Cheo 35.*

A species distinctive because of the fine texture of the elliptic leaves and the very small (3 mm. diam.) globose fruit, subtended by a calyx scarcely enlarged.

11. **Litsea ichangensis** Gamble in Sargent, Pl. Wilson. **2**: 77. 1914; Chun, Contr. Biol. Lab. Sci. Soc. China, **1**^{5}: 58. 1925; Liou, Laurac. Chine Indoch. 180. 1932.

DISTRIBUTION: known only from type locality.

CHINA. HUPEH: *E. H. Wilson 297; Veitch Exped. 34* (syntypes not seen, Kew); *E. H. Wilson 298* (syntype, Kew; isotype AA).

The species resembles the Genus *Cinnamomum* in the frequent occurrence of glands in the axils of the veins on the under surfaces of the leaves, and in the spicy lemon-like odor of the bark and leaves. The latter are ovate, obtuse and very small, usually under 4 cm. long.

12. **Litsea Chenii** Liou, Laurac. Chine Indoch. 183. 1932.

Distribution: known only from type locality.
China. szechuan: *S. Chen 7091* (type not seen, Paris).

Liou states that this species is similar to *Litsea rubescens* Lecomte but differs in the disposition of the anthers of the third cycle of stamens, the pubescent filaments, the larger leaves which are pubescent below, and the more numerous secondary nerves. He states also that it is near *Litsea mollifolia* Chun, but has solitary, larger umbels, larger leaves, etc.

13. **Litsea Chunii** Cheng, Contr. Biol. Lab. Sci. Soc. China, **9**: 196, fig. 19. 1934.

Distribution: known only from type localities.
China. szechuan: *W. C. Cheng 672* (syntype not seen, Fan Mem. Inst. Biol. ?). —sikiang: *W. C. Cheng 1173* (syntype not seen, Fan Mem. Inst. Biol. ?); *W. C. Cheng 924, 926* (paratype, Fan Mem. Inst. Biol.).

Chen places this species near *Litsea pungens* Hemsl., from which it differs in the usually smaller elliptic-lanceolate leaves almost glabrous beneath, even when young; in the oblong or ovate-oblong perianth lobes and glabrous stamens; and in the ovoid fruit. I have seen no representative of this species.

14. **Litsea rubescens** Lecomte, Nouv. Arch. Mus. Hist. Nat. Paris, sér. V. **5**: 86. 1913; Liou, Laurac. Chine Indoch. 183. 1932.

Distribution: western China.
China. kient chang: *A. F. Legendre 1385* (type not seen, Paris).

14a. **Litsea rubescens** Lecomte var. **yunnanensis** Lecomte, Nouv. Arch. Mus. Hist. Nat. Paris, sér. V. **5**: 86. 1913; Liou, Laurac. Chine Indoch. 183. 1932.

Distribution: western China.
China. yunnan: *J. M. Delavay 4020* (type, Paris).—szechuan: *W. P. Fang 808*.—kweichow: *W. Y. Chun 7338*.

Both the species and the variety are characterized by the buds being extremely apiculate before anthesis. The variety has round leaves that are longer than those of the species. The leaves of the species are 4–6 cm. long, 1.7–2.2 cm. broad.

14b. **Litsea rubescens** Lecomte f. **tonkinensis** Liou, Laurac. Chine Indoch. 183. 1932.

DISTRIBUTION: French Indo-China.
FRENCH INDO-CHINA. TONKIN: *E. Poilane 12625* (type not seen, Paris).

This differs from var. *yunnanensis* in having longer leaves and longer fruiting pedicels.

15. **Litsea verticillata** Hance, Jour. Bot. **21**: 356. 1883; Hemsl. Jour. Linn. Soc. Bot. **26**: 386. 1891; Chun, Contr. Biol. Lab. Sci. Soc. China, 1^5: 65. 1925; Liou, Laurac. Chine Indoch. 171. 1932; Merr. Lingnan Sci. Jour. **16**: 190. 1937.

Litsea multiumbellata Lecomte, Nouv. Arch. Mus. Hist. Nat. Paris, sér. V. **5**: 85. 1913; Fl. Gén. Indoch. **5**: 133. 1914; Liou, Laurac. Chine Indoch. 171. 1932.
Litsea brevipetiolata Lecomte, Fl. Gén. Indoch. **5**: 132. 1914, pp.

DISTRIBUTION: French Indo-China to China.
CHINA. KWANGTUNG: *B. C. Henry, Herb. Hance 22051* (type of *Litsea verticillata*, Brit. Mus.); *C. O. Levine 359*.—HAINAN: *S. K. Lau 1502, 2581, 3828; H. Fung 20407; H. Y. Liang 62626, 62149, 63520.* Numerous other collections have been examined.
FRENCH INDO-CHINA. TONKIN: *D. Bois 230* (syntype of *Litsea brevipetiolata*, Paris).—CAMBODIA: *L. Pierre 643* (type of *Litsea multiumbellata*, Paris; isotype, AA).

This species is extremely variable in leaf structure and in inflorescence. Typical *Litsea verticillata* has branchlets densely ferrugineous-hirsute, finally glabrous; leaves verticillate, penninerved, subsessile, lanceolate or lanceolate-oblong, base obtuse, apex gradually acuminate, hirtellous to glabrous above, venation ferrugineous-hirtellous below, bracts of inflorescence cano-sericeous on the outside. These characters are all variable: the degree which the leaves are sessile, the leaf base, the leaf shape, venation and pubescence, and the length of the pedicels of the inflorescence. There is an intergradation of all of these, also, to be found on an examination of numerous herbarium specimens. The following varieties which have been retained represent the extremes of variation within the species.

15a. **Litsea verticillata** f. **annamensis** (Liou), comb. nov.

Litsea multiumbellata Lecomte f. *annamensis* Liou, Laurac. Chine Indoch. 171. 1932.

Distribution: French Indo-China and China.
French Indo-China. annam: *E. Poilane 7547* (type, Paris; photo., AA).
China. yunnan: *H. T. Tsai 61180, 61379, 61501, 61613.*

It is with some hesitation that I have included the Yunnan specimens under this variety, since I have only the photograph of the type for comparison. The leaves of the former seem to be on the whole rather more acuminate, and the umbels somewhat shorter in several cases. The venation and pubescence, as far as can be judged, agree with the variety. Liou gives as a diagnostic character the size of the umbels as 8 mm. before anthesis. This increase in size seems to be prevalent in the *verticillata* group, and does not therefore have a great deal of value as a varietal character. The number of flowers, which he gives as five, is variable also. Likewise, leaf-length varies. The very loose reticulation is a distinctive character.

15b. **Litsea verticillata** var. **brevipes** Merr. & Metc. in Lingnan Sci. Jour. **16**: 81. 1937.

Distribution: China.
China. kwangtung: *W. T. Tsang 16602* (type, Lingnan U.; isotype, NY).

This is very similar to var. *brevipetiolata* (Lecomte) Allen in that the leaf bases are the same. The inflorescence, however, is sessile.

15c. **Litsea verticillata** Hance var. **brevipetiolata** (Lecomte), comb. nov.

Litsea brevipetiolata Lecomte, Fl. Gén. Indoch. **5**: 132. 1914, pp.; Liou, Laurac. Chine Indoch. 172. 1932.

Distribution: French Indo-China.
French Indo-China. tonkin: *H. Bon 3311* (syntype, Paris); *Mouret, B. Balansa* (syntypes not seen, Paris); *W. T. Tsang 23038?* (differs from the type in having a less dense pubescence).

I have seen only two of the four types on which Lecomte based his description of *L. brevipetiolata. Bon No. 3311,* I take to be typical. *Bois No. 230,* also from Tonkin, is a typical *Litsea verticillata* described from Kwangtung. The petioles vary in length, and the leaves are acute at the base, with the typical under-surface, venation and pubescence typical of the latter species. In *Litsea brevipetiolata* the leaves are rounded at the

base, abruptly contracted or subauriculate, and in *L. verticillata,* obtuse or sometimes subrotund.

16. **Litsea honghoensis** Liou, Bull. Soc. Bot. France, **80**: 567. 1933.

Litsea wenshanensis Hu, Bull. Fan Mem. Inst. Biol. **5**: 308. 1934; Hu in Hu & Chun, Ic. Pl. Sin. **4**: 10, pl. 160. 1935, **syn. nov.**

DISTRIBUTION: China (Yunnan).
CHINA. YUNNAN: *H. T. Tsai 51726* (type of *Litsea wenshanensis,* Fan Mem. Inst. Biol.; isotype, AA), *51502, 51555* (paratypes of *Litsea wenshanensis,* Fan Mem. Inst. Biol.; isotypes, AA); *A. Henry 10856A* (type of *L. honghoensis* Liou, NY; isotype, AA).

This Yunnan species is distinguished by its large (10–13 cm. long × 4–6 cm. broad), coriaceous, oblong-elliptic to obovate leaves, yellow-green above, glaucous below, the veins red to yellow. The inflorescence consists of numerous fascicled or solitary umbels.

Liou, in 1933, has tentatively described *Litsea ? honghoensis.* He has only ♀ flowers. He gives no collector. The title indicates that the species is from Yunnan. By chance, I found the type specimen so labeled in the N. Y. Herb. There is no difference apparent between the two species *L. honghoensis* and *L. wenshanensis,* the latter automatically falling into synonymy under the former.

17. **Litsea grandifolia** Lecomte, Nouv. Arch. Mus. Hist. Nat. Paris, sér. V. **5**: 87. 1913; Fl. Gén. Indoch. **5**: 141. 1914; Liou, Laurac. Chine Indoch. 175. 1932.

DISTRIBUTION: known only from type locality.
FRENCH INDO-CHINA. COCHINCHINA: *L. Pierre 5149* (type, Paris).

This seems to be near *Litsea baviensis* Lecomte, or its variety *szemaoïs* (Liou) Allen, but the leaves are much larger, and the fruit is borne in clusters on a longer peduncle.

18. **Litsea Griffithii** Gamble var. **annamensis** Liou, Laurac. Chine Indoch. 193. 1932.

DISTRIBUTION: French Indo-China.
FRENCH INDO-CHINA. ANNAM: *E. Poilane 10524, 16581* (syntypes, Paris); *J. & M. S. Clemens 4242.*—TONKIN: *E. Poilane 13132* (syntype, Paris).

Both the species and the variety are very striking plants with large coriaceous elliptic leaves 10–15 cm. in length, 5–8 cm. broad, greenish yellow above, very pale below, lightly covered with reddish pubescence, the veins ascending-arcuate and densely ferrugineous-tomentose. The branchlets and petioles also are densely appressed-tomentose. The differences between the species and the variety as given by Liou seem to be differences in degree of variation. Without examining all of the specimens cited both for the species and the variety, the true status of the variety in relation to the species cannot be ascertained.

19. **Litsea Clemensii**, spec. nov.

Arbor parva, ramulis teretibus rubescentibus striatulis ex pubescentibus glabrescentibus. Folia opposita, satis coriacea, oblongo-elliptica, 12–20 cm. longa, 4–5.5 cm. lata, acuta vel acuminata, supra inconspicue subtus prominenter reticulata, ex glabrescentibus glabra, margine laxe undulata, penninervia, nervis 8–10 arcuatis, supra inconspicuis subtus elevatis, petiolis 8–22 mm. longis, glabrescentibus. Inflorescentia subumbellata, solitaria, pauciflora, axillaris vel subterminalis, breviter pedunculata. Flores ♂ et ♀ ignoti. Fructus late ellipsoideus, 10 mm. longus, 8 mm. latus, cupula 3–4 mm. longa, 6–8 mm. lata, pateriformi, matura utrinque glabra sessili.

DISTRIBUTION: French Indo-China.

FRENCH INDO-CHINA. ANNAM: *J. & M. S. Clemens 3268* (type, AA).

The sessile subumbels, of which only 1 or 2 flowers develop into mature fruit, present an unusual appearance. For the most part, two mature fruits are seen side by side at maturity.

This species is named for the late Chaplain and Mrs. Clemens who have contributed largely to our Indochinese collections.

20. **Litsea baviensis** Lecomte, Nouv. Arch. Mus. Hist. Nat. Paris, sér. V. 5: 87. 1913; Fl. Gén. Indoch. 5: 142. 1914; Liou, Laurac. Chine Indoch. 176. 1932.

Litsea Maclurei Merr. Philip. Jour. Sci. 23: 244. 1923; Liou, Laurac. Chine Indoch. 178. 1932, syn. nov.

DISTRIBUTION: China and French Indo-China.

FRENCH INDO-CHINA. TONKIN: Mont Bavi, *B. Balansa 2401* (type of *L. baviensis*, Paris; photo. and fragm., AA).—ANNAM: *E. Poilane 22073, 23750.*

CHINA. HAINAN: *F. A. Maclure 9586* (type of *L. Maclurei*, Herb. Manila; isotype, AA); *H. Fenzel 90; W. T. Tsang & H. Fung 575, 619; W. T. Tsang 692; S. K. Lau 1620, 2927, 3600, 3861; F. C. How 70389, 72160; H. Y. Liang 62439, 64288, 64910; C. Wang 33535, 33541, 34315, 35289.*

The above-mentioned species is characterized by coriaceous, oblong or lanceolate leaves up to 20 cm. long, yellow-green above and glaucous below. The black glabrous fruit is enclosed in a large fleshy, greyish truncate verrucose cupule or induvium which is glabrous. Liou suggests the similarity of the two species but keeps them distinct because of more visible veins on the lower surface of *L. baviensis* Lecomte, and its longer peduncles. I have the types of both before me, and the differences do not seem important enough to warrant retaining them as separate species.

20a. **Litsea baviensis** Lecomte var. **szemaoïs** (Liou), comb. nov.

Litsea Pierrei Lecomte var. *szemaoïs* Liou, Laurac. Chine Indoch. 174. 1932.

DISTRIBUTION: known only from type locality.

CHINA. YUNNAN: Szemao, *A. Henry 12025* (type of *L. Pierrei szemaoïs*, NY; isotype, AA).

Liou mentions the similarity of the variety to *Litsea Maclurei* Merr. (now *L. baviensis* Lecomte), which seems to be a nearer relation than *L. Pierrei* Lecomte. The leaf characters certainly do not resemble those of the latter. The inflorescence of *L. baviensis* Lecomte is fasciculate while in the variety *szemaoïs* Liou, it is of a racemose type. The latter, however, is quite distinct from that of *L. Pierrei* Lecomte, the raceme of which breaks up into numerous individual flowers. In the variety, the ultimate branchlets consist of several-flowered umbels. Of the two types of inflorescence, the latter has a closer affinity to the fascicle than the racemose type of *L. Pierrei* Lecomte. For these reasons, the variety has been transferred to *L. baviensis* Lecomte.

21. **Litsea chartacea** (Nees) Hook. f. Fl. Brit. Ind. 5: 170. 1886.

Tetranthera chartacea Wall. ex Nees in Wall. Pl. As. Rar. 2: 67. 1831; 3: 30. 1832.

Litsea Eberhardtii Liou, Laurac. Chine Indoch. 181. 1932, **syn. nov.**

Litsea baviensis Lecomte var. *venulosa* Liou, Laurac. Chine Indoch. 177. 1932, **syn. nov.**

Distribution: India through French Indo-China to western China.

India. nepal: *N. Wallich 2531* (isotype of *Tetranthera chartacea*, Kew, see footnote, p. 370).—e. himalaya: *W. Griffith 4292.*

French Indo-China. tonkin: *P. Eberhardt 4950* (type of *Litsea Eberhardtii*, Paris; photo., AA); *E. Poilane 13117.*—annan: *E. Poilane 10697* (type of *Litsea baviensis* var. *venulosa*, Paris; photo., AA).

China. yunnan: Szemao, *A. Henry 12013.*

Although the photograph alone of *Litsea Eberhardtii* Liou is at hand there seems no doubt that this plant is conspecific with *Litsea chartacea* from Nepal. The type of *Litsea baviensis* Lecomte var. *venulosa* Liou agrees perfectly with the latter. The question of reticulation, which does not show in detail in the photograph, is not mentioned in the description of *L. Eberhardtii*, but the type of *L. Eberhardtii* var. *subtriplinervis* Liou shows a reticulation similar to that of *L. chartacea* (Nees) Hook. f. It seems a reasonable assumption that a like situation obtains in the species proper. *Poilane 13117*, from Tonkin, cited by Liou under *Litsea baviensis* Lecomte, is a fruiting specimen showing no similarity to the fruit of the latter. The leaves in every respect correspond to those of *L. chartacea.* Both the type of *L. Eberhardtii* Liou, and Poilane's fruiting specimen were collected in the vicinity of Hanoi, Tonkin; the former in the province of Vinh-yen, to the north, the latter near Chobo, to the southwest.

21a. **Litsea chartacea** (Nees) Hook. f. var. **subtriplinervis** (Liou), comb. nov.

Litsea Eberhardtii Liou var. *subtriplinervis* Liou, Laurac. Chine Indoch. 181. 1932.

Distribution: known only from type locality.

French Indo-China. tonkin: *P. Eberhardt 4949* (type of *Litsea Eberhardtii* var. *subtriplinervis*, Paris; photo. and fragm., AA).

The affinity between the species proper and the variety is very evident on examination of the types, the distinguishing

character being an approach to a triplinerviate condition at the leaf bases.

22. **Litsea lancilimba** Merr. Philip. Jour. Sci. **23**: 244. 1923; Liou, Laurac. Chine Indoch. 176. 1932.

DISTRIBUTION: French Indo-China (?) and southern China (Hainan).

CHINA. HAINAN: *F. A. McClure (C.C.C.) 9353* (type, Herb. Manila; photo., AA); *F. C. How 73219; N. K. Chun & C. L. Tso 44354; C. Wang 35362; H. Y. Liang 64800.*

I have seen no flowers of this species. The leaves are very striking, long-lanceolate, acuminate, more or less glaucous below, and green above. Liou reports this as occurring in French Indo-China, but I have found no specimen of it in the material I have examined.

23. **Litsea longipes** (Meissn.) Hook. f. Fl. Brit. Ind. **5**: 172. 1886; Lecomte, Fl. Gén. Indoch. **5**: 141. 1914; Liou, Laurac. Chine Indoch. 175. 1932.

Cylicodaphne longipes Meissn. in DC. Prodr. 15^1: 205. 1864.

DISTRIBUTION: India and French Indo-China.

INDIA. MERGUI: *W. Griffith* (type, Kew); *Helfer, Kew Distrib. No. 4281* (cited by Hooker *f.*).

Lecomte has reported this from Indo-China, but I have seen no specimens from there. The species has very distinctive fruit when dried, borne in pedunculate umbels of threes, the cupule being 1.5 cm. in diam., very fleshy, and the pedicel 3 cm. long. On drying the cupule appears rugose. The leaves are large (20 × 8 cm.), coriaceous, elliptic, yellow-green above, glaucous below. Except for the numbers cited above, I have seen no material of *L. longipes.*

24. **Litsea Helferi** Hook. f. var. **laosensis** Liou, Laurac. Chine Indoch. 180. 1932.

DISTRIBUTION: known only from type locality.

FRENCH INDO-CHINA. LAOS: *E. Poilane 2086* (type, Paris).

There does not appear to be a very close relationship between the two entities. Liou emphasizes the fact that in the variety the umbels are larger; the leaves are larger and more

coriaceous; the petioles are longer; the secondary nerves are impressed above, but show a slight elevation as well. These differences would be variations of degree only, if the plants were similar in other respects, which is not the case. The leaves of the variety are not symmetrical in outline, while those of the species proper are usually elliptical-ovate.

25. **Litsea eugenioides** A. Chev. in Liou, Laurac. Chine Indoch. 173. 1932.

DISTRIBUTION: known only from type locality?

FRENCH INDO-CHINA. ANNAM: *A. Chevalier 38667; E. Poilane 3658* (syntypes, Paris).

These two numbers constitute the only material seen of this species. The nearest related species seems to be *Litsea nitida* (Nees) Hook. f. from India. The unusual raised venation is characteristic of both species. The ♂ inflorescence of the latter is a full-flowered raceme. The ♀ inflorescence is shorter. The ♂ inflorescence of *L. eugenioides* is unknown; the ♀ inflorescence is a short axillary cluster of umbels or merely isolated umbels. The leaves of *L. nitida* are longer and more slender, and the venation less conspicuous on the lower surface than those of *L. eugenioides.* It is possible that there is one species only represented here, but I have for study only a portion of Wallich's type of *Tetranthera nitida* consisting of a ♂ branch. Before making any change of status more material is necessary.

26. **Litsea Liyuyingi** Liou, Bull. Soc. Bot. France, **80**: 566, fig. 1. 1933.

DISTRIBUTION: known only from type locality.

CHINA. YUNNAN: *A. Henry 12839* (type, NY).

Liou has created, on the strength of this species, a new subgenus *Octolitsea,* because of the numerous stamens and the eight-parted perianth. It is a coarse-leaved species not unlike *L. honghoensis,* but differing from it in having an inflorescence of panicles of cymes.

27. **Litsea Panamonja** (Nees) Hook. f. Fl. Brit. Ind. **5**: 175. 1886; Liou, Laurac. Chine Indoch. 175. 1932.

Tetranthera Panamonja Hamilt. in Wallich List No. 2553. 1830.
Tetranthera Panamanja Nees in Wall. Pl. As. Rar. 2: 67. 1831.

DISTRIBUTION: India and French Indo-China.

INDIA. SILHET: *N. Wallich 2553* (isotype, Kew, not seen; Gray, see footnote p. 370).

FRENCH INDO-CHINA. TONKIN: *P. Eberhardt 3241.*

A large-leaved penninerved species distinguished by its numerous racemes often 6 cm. long.

28. **Litsea Rehderiana,** spec. nov.

Arbor 15–18 m. alta, ramulis teretibus rugosis viridi-brunneis, glabris. Folia in apice ramulorum verticillata, subcoriacea, elliptica, 12–17 cm. longa, 4–6.5 cm. lata, acuta, acuminata vel subacuminata ad basin subrotundata, utrinque glabra, supra viridia, minute reticulata sub lente, subnitida, subtus pallida, glaucescentia, penninervia, nervis 7–9-jugis, supra pro ratione laminae coloris perspicuis sicut venulis flavis, subtus primo intuito obscurioribus sed prominulis, petiolis 12–30 mm. longis, glabris rugosis. Inflorescentia coarctata, racemosa, umbellam simulans. Flores ♂ immaturi, ut videtur generis, staminibus 9. Flores ♀ ignoti. Inflorescentia fructifera, 3–3.5 cm. longa, pedicellis 1–1.5 cm. longis. Fructus magnus, globosus, 2 cm. latus, rugosus, cupula glabra in sicco, 5–7 mm. longa, 10–12 mm. lata, in pedicellum clavatum 16–20 mm. longum et 4–6 mm. crassum, abrupte abeunte.

DISTRIBUTION: French Indo-China.

FRENCH INDO-CHINA. ANNAM: *E. Poilane 24353, 23907* (type, Paris; photo. and fragm., AA).

A very striking species of *Litsea* on account of the enormous globose fruits which are borne in racemose clusters on the branches and are subtended by a thick enlarged calyx and pedicel, together forming a constricted funnel-shaped cupule. The reticulation of the upper surface of the leaf is unusual in that under a lens it appears yellowish, as do the veins, against the dark background of the leaf blade.

It gives me great pleasure to name this species in honor of Prof. Alfred Rehder, Curator of the Herbarium of the Arnold Arboretum, long renowned as an authority on oriental ligneous plants.

29. **Litsea Pierrei** Lecomte, Nouv. Arch. Mus. Hist. Nat. Paris, sér. V. 5: 83. 1913; Fl. Gén. Indoch. 5: 138. 1914; Liou, Laurac. Chine Indoch. 174. 1932.

Litsea Vang Lecomte, Nouv. Arch. Mus. Hist. Nat. Paris, sér. V. 5: 84. 1913; Fl. Gén. Indoch. 5: 139. 1914; Liou, Laurac. Chine Indoch. 175. 1932, syn. nov.

DISTRIBUTION: French Indo-China.

FRENCH INDO-CHINA. COCHINCHINA: *L. Pierre 471, 5151* (syntypes of *Litsea Pierrei*, Paris); *L. Pierre 125* (type of *Litsea Vang*, Paris).

This is a species where the ovary is almost completely enclosed in the enlarged perianth tube or induvium, which in the young fruiting stage enlarges to almost surround the fruit. In the mature stage, the fruit protrudes from the spread calyx about one-half its length. This situation is comparable to that found in *Litsea baviensis* Lecomte from which *L. Pierrei* is distinguished by the smaller leaves, non-verrucose calyx and oblong fruit. It seems to be a difference in the age of the fruiting specimens which separates the two species of Lecomte, *L. Pierrei* and *L. Vang*. Hence, I have reduced the latter to *L. Pierrei* Lecomte.

29a. **Litsea Pierrei** Lecomte var. **grandifolia** (Lecomte), comb. nov.

Litsea Vang Lecomte var. *grandifolia* Lecomte, Nouv. Arch. Mus. Hist. Nat. Paris, sér. V. 5: 84. 1913; Fl. Gén. Indoch. 5: 139. 1914; Liou, Laurac. Chine Indoch. 165. 1932.

DISTRIBUTION: known only from type locality.

FRENCH INDO-CHINA. CAMBODIA: *L. Pierre 5152* (type, Paris).

This is a very large-leaved variety of the species.

29b. **Litsea Pierrei** Lecomte var. **lobata** (Lecomte), comb. nov.

Litsea Vang Lecomte var. *lobata* Lecomte, Nouv. Arch. Mus. Hist. Nat. Paris, sér. V. 5: 84. 1913; Fl. Gén. Indoch. 5: 139. 1914; Liou, Laurac. Chine Indoch. 165. 1932.

DISTRIBUTION: French Indo-China.

FRENCH INDO-CHINA. CAMBODIA: Ile Phu-Quoc, *L. Pierre 5150* (type, Paris).

The species and the variety are very similar. The lobing of the cupule mentioned by Lecomte is not apparent on the sheet

of the type at hand. The fruit of the variety is more broadly oblong than the fruit of the species. The leaves of the variety are more cuneate at the base and the venation more apparent on the upper surface. Otherwise, the two entities are similar.

30. **Litsea cambodiana** Lecomte, Nouv. Arch. Mus. Hist. Nat. Paris, sér. V. 5: 82, pl. 5. 1913; Fl. Gén. Indoch. 5: 139, fig. 12. 1914; Liou, Laurac. Chine Indoch. 172. 1932.

DISTRIBUTION: French Indo-China.
FRENCH INDO-CHINA. CAMBODIA: *Bordenave* (type, Paris).

A coarse species which is distinctive because of the extremely coriaceous leaves, which are truly elliptical, 10–15 cm. long and 4.5–7.5 cm. broad, penninerved, with nerves conspicuous only below, spreading and ascending at the tips. The inflorescence is racemose.

30a. **Litsea cambodiana** Lecomte var. **longiracemosa** Lecomte, Nouv. Arch. Mus. Hist. Nat. Paris, sér. V. 5: 82. 1913; Fl. Gén. Indoch. 5: 141. 1914; Liou, Laurac. Chine Indoch. 173. 1932.

DISTRIBUTION: French Indo-China.
FRENCH INDO-CHINA. COCHINCHINA: *L. Pierre 229* (type, Paris).

30b. **Litsea cambodiana** Lecomte var. **multiracemosa** Lecomte, Nouv. Arch. Mus. Hist. Nat. Paris, sér. V. 5: 82. 1913; Fl. Gén. Indoch. 5: 141. 1914; Liou, Laurac. Chine Indoch. 173. 1932.

DISTRIBUTION: French Indo-China.
FRENCH INDO-CHINA. CAMBODIA: *L. Pierre 1467a* (type, Paris).

The types of the two varieties proposed by Lecomte certainly show the differences mentioned by him in the original descriptions, but I feel very strongly that could an abundance of material from Indo-China be obtained, the three specimens cited above would fall into a series showing merely variations within the species proper. In the larger scope it is possible that the above species, *Litsea Pierrei* Lecomte, and *L. Vang* Lecomte might together constitute a single species with variations which one might put down as being due to ecological conditions.

31. **Litsea Thorelii** Lecomte, Nouv. Arch. Mus. Hist. Nat. Paris, sér. V. **5**: 85. 1913; Fl. Gén. Indoch. **5**. 137. 1914; Liou, Laurac. Chine Indoch. 182. 1932.

DISTRIBUTION: India and French Indo-China.

FRENCH INDO-CHINA. COCHINCHINA: *M. C. Thorel 3367* (type, Paris).

A species with nearly linear leaves, crowded at the tips of the branches. The inflorescence consists of umbels reduced to one flower subtended by a broadly spreading "involucre." The species is similar to *Litsea pseudoelongata* Liou, but has broader leaves, shorter pedicels, and the bracts are covered with brownish pubescence.

32. **Litsea pseudoelongata** Liou, Laurac. Chine Indoch. 179, fig. 13. 1932.

DISTRIBUTION: China (Kwangtung and Hainan).

CHINA. KWANGTUNG: *Y. Tsiang 2590* (type, NY); *W. Y. Chun 7358* (sterile specimen).—HAINAN: *F. C. How 73869.*

The *How* specimen has immature fruit, too young to complete the description. The species recalls *Litsea Thorelii* Lecomte, from Cochinchina, but may be separated from the latter by longer, more numerous, more slender obtuse leaves; more numerous and more spreading veins, which are less conspicuous on the upper surface; and the cano-sericeous bracts subtending the umbels.

33. **Litsea glutinosa** (Lour.) C. B. Rob. Philip. Jour. Sci. Bot. **6**: 321. 1911; Chun, Contr. Biol. Lab. Sci. Soc. China **1**^{5}: 62. 1925; Merr. Enum. Philip. Fl. Pl. **2**: 194. 1923; Trans. Am. Philos. Soc. n. ser. **24**^{2}: 166 (Comm. Loureiro Fl. Cochinch.). 1935.

Sebifera glutinosa Lour. Fl. Cochinch. 638. 1790; ed. 2, 783. 1793.

Litsea Sebifera Pers. Syn. **2**: 4. 1807 (based on *Sebifera glutinosa* Lour.); Liou, Laurac. Chine Indoch. 196. 1932.

For complete synonymy see Merrill, l.c.

DISTRIBUTION: Tropical Asia to Malaysia.

FRENCH INDO-CHINA. ANNAM: *R. W. Squiers 351; J. & M. S. Clemens 3247.*

COCHINCHINA. *J. Loureiro* (type of *Sebifera glutinosa* not seen, Paris, Brit. Mus.).

CHINA. YUNNAN: *A. Henry 12223*, and *12223 A, B, C, D*, and *F.*

Over one hundred additional sheets of this species were examined, but they will not be listed here, since the species is very well known.

There occurs in this species variation in size and shape of leaf, and in the inflorescence, which is composed of many-flowered (8–10) umbels. The leaves are very prominently reticulate, glabrous above, with varying degrees of pubescence below (usually extremely pubescent). The flower perianths are incomplete through abortion.

33a. **Litsea glutinosa** (Lour.) C. B. Rob. var. **brideliifolia** (Hay.) Merr. Lingnaam Agr. Rev. 1²: 84. 1923; Lingnan Sci. Jour. 5: 80. 1927.

Litsea brideliifolia Hay. Ic. Pl. Formos. 5: 166, fig. 58b. 1915.
Tetradenia brideliifolia (Hay.) Makino & Nemoto, Fl. Jap. ed. 2, 373. 1931.
Litsea Sebifera Pers. var. *brachyphylla* Hand.-Maz. Oest. Bot. Zeit. 80: 341. 1931.

DISTRIBUTION: southern Asia.

CHINA. HAINAN: *N. Konishi 70* (type of *Litsea brideliifolia* not seen, Taihoku Herb.); *H. Fenzel 4* (type of *Litsea Sebifera* var. *brachyphylla* not seen, Vienna); *A. Henry 8081, 8472; J. L. Gressitt 783, 1417; H. Y. Liang 63804; C. Wang 32724; S. K. Lau 22, 1583, 3539; Y. Tsiang 429; W. T. Tsang 177, 667; C. O. Levine 1248; W. Y. Chun 15; F. A. McClure 8984.*

FRENCH INDO-CHINA. ANNAM: *J. & M. S. Clemens 3305.*

Handel-Mazzetti, in a letter to Merrill, says: "*Litsea brideliaefolia* has, from the description, twigs and petioles hirsute, my plant at best puberulent, leaves with acute base, 7–8 pairs of nerves, mine with mostly rounded base and 5–6 pairs nerves. This may, however, be variable and that inexactly described."

34. **Litsea rotundifolia** Hemsl. Jour. Linn. Soc. Bot. 26: 385. 1891.

Laurus rotundifolia Wall. List. no. 2591. 1830, nomen nudum.
Iozoste rotundifolia Nees in Wall. Pl. As. Rar. 2: 63. 1831 (based on *Tetranthera rotundifolia* Wall.).
Tetranthera rotundifolia Wall. ex Nees l.c. in synon. (based on *Laurus rotundifolia* Wall.).
Actinodaphne chinensis var. *rotundifolia* Nees, Syst. Laurin. 600. 1836 (based on *Tetranthera rotundifolia* Wall.).
Iozoste chinensis var. *rotundifolia* Bl. Mus. Bot. Lugd.-Bat. 1: 364. 1851 (based on *Tetranthera rotundifolia* Wall.).
Actinodaphne rotundifolia Merr. Lingnan Sci. Jour. 15: 419. 1936, synon. pp., syn. nov.

DISTRIBUTION: southern China.

CHINA. *N. Wallich 2591* (isotype of *Iozoste* and *Tetranthera rotundifolia*, not seen, Kew, see footnote p. 370).—KWANGTUNG: *W. A. Harland* (type of *Litsea rotundifolia* Hemsl., Kew; photo., AA).

Except for the specimens cited above I have seen no material of the species proper. According to the International Rules, there is no reason why Hemsley's name should not be the one to be used, even though it by chance happens to be the same which the transfer of the oldest specific epithet would automatically give to the species. Inasmuch as Hemsley's name was published several years ago the specific epithet "rotundifolia" cannot now be transferred, since it would result in a later homonym. The species is easily distinguished by the rotund or ovate leaves, obtuse or acutish at the apex, with very distinct venation.

34a. **Litsea rotundifolia** Hemsl. var. **oblongifolia** (Nees), comb. nov.

Litsea chinensis Bl. Bijdr. 565. 1825, non Lam.

Iozoste rotundifolia Nees var. *oblongifolia* Nees in Hook. f. & Arnott, Bot. Beechey Voy. 209. 1836 (based on *Litsea chinensis* Bl.).

Actinodaphne chinensis var. *oblongifolia* Nees, Syst. Laurin. 600. 1836 (based on *Litsea chinensis* Bl.).

Iozoste chinensis Bl. Mus. Bot. Lugd.-Bat. 1: 364. 1851 (based on *Litsea chinensis* Bl.).

Actinodaphne chinensis Nees, Syst. Laurin. 600. 1836; Lecomte, Nouv. Arch. Mus. Hist. Nat. Paris, sér. V. 5: 93. 1913; Liou, Laurac. Chine Indoch. 159. 1932.

Blume's type of *Litsea chinensis* not seen, Leiden.

Distribution: southern and eastern China and possibly French Indo-China.

China. kwangtung: *W. Y. Chun 7506* (type, AA); *C. O. Levine 8, 437, 567, 992, 1250, 1619, 1622, 1824* (some of the leaves of this specimen are very nearly rotund, others are oblong, which shows the rather artificial separation of the variety from the species), *3009, 3064; C. O. Levine & G. W. Groff 85; W. T. Tsang 16502, 21199, 21210, 21562; Y. Tsiang 887, 888, 890, 1502, 1529.*—hainan: *F. C. How 73606.*—fukien: *H. H. Chung 1054, 2175, 2233, 4522, 6871; S. G. Tang 5347, 6784; S. P. Wong 12298; O. Warburg 5839.*—kwangsi: *R. C. Ching 7836* (very small-leaved specimen).

French Indo-China. tonkin: *B. Balansa 4756?*

The variety is similar to the species except for the leaves of the former being oblong or elliptic rather than rotund.

The variety has been known in herbaria as *Litsea* or *Actinodaphne chinensis*. The material which has come to my attention has proved to be a mixture of two different elements: the variety proper, the majority of the specimens of which are from Kwangtung and Fukien; and *Actinodaphne lancifolia*

var. *sinensis* Allen. Because there has been a confusion in determination for so long, I have cited above all of the recent collections of *Litsea rotundifolia oblongifolia,* duplicates of which appear in the various herbaria throughout the world. Specimens belonging to *Actinodaphne* will likewise be cited under that genus.

35. **Litsea firma** Hook. f. var. **austrannamensis** Liou, Laurac. Chine Indoch. 191. 1932.

DISTRIBUTION: known only from type locality.

FRENCH INDO-CHINA. ANNAM: *A. Chevalier 38727* (type, Paris; photo., AA).

Only a photograph of this variety has been seen. It differs from the species proper (fide Liou) in having smaller leaves, petioles and umbels, and fewer secondary nerves.

36. **Litsea monopetala** (Roxb.) Pers. Syn. **2**: 4. 1807.

Tetranthera monopetala Roxb. Pl. Corom. **2**: 26, pl. 148. 1798; Nees in Wall. Pl. As. Rar. **2**: 66. 1831; Meissn. in DC. Prodr. **15**[1]: 189. 1864.

Tetranthera macrophylla Roxb. Hort. Bengal. 73. 1814.

Tetranthera macrophylla Roxb. in Wall. List No. 2549. 1830.

Litsea polyantha Juss. Ann. Mus. Hist. Nat. Paris, **6**: 211. 1805; Hook. f. Fl. Brit. Ind. **5**: 162. 1886; Lecomte, Nouv. Arch. Mus. Hist. Nat. Paris, sér. V. **5**: 89. 1913; Fl. Gén. Indoch. **5**: 135. 1914; Chun, Contr. Biol. Lab. Sci. Soc. China. **1**[5]: 63. 1925; Liou, Laurac. Chine Indoch. 192. 1932.

Tetranthera polyantha Wall. List No. 2538. 1830, nomen nudum; ex Nees in Wall. Pl. As. Rar. **2**: 67. 1831.

DISTRIBUTION: southern Asia and Pacific Islands.

INDIA. SILHET: *N. Wallich 2538* (isotype of *Tetranthera polyantha* not seen, Kew, see footnote p. 370); *N. Wallich 2549* (isotype of *T. macrophylla* Roxb., Kew, Gray).

CHINA. YUNNAN: *H. T. Tsai [55027, 55039, 55052, 56682], 60712, 60854; A. Henry 11794, 12005.*—HAINAN: *S. K. Lau 1385, 1326; W. T. Tsang & H. Fung 208; W. T. Tsang 121, 610; H. Fung 20059; H. Y. Liang 61952, 64190; C. Wang 35741, 36185; F. C. How 71318, 71691.*

FRENCH INDO-CHINA. ANNAM: *E. Poilane [24733]; A. Chevalier [40449].*—WITHOUT LOCALITY: *E. Poilane [21772].*

The species is characterized by the soft rusty pubescence of the inflorescence and the under surface of the ovate or obovate to oval-oblong leaves. The inflorescence consists of numerous pedunculate umbels. The above specimens from China and Indo-China are bracketed because they conform to the typical *L. monopetala* in spite of having glabrous to glabrescent leaves

and branchlets. At this point attention should be called to the variety *glabra* from Hainan which Liou published under *Litsea polyantha.* This has no affinity either in leaf or fruit character which could place it near *L. polyantha.* Its proper position seems to be as a variety of *L. salicifolia,* which species see for discussion.

37. **Litsea Wilsonii** Gamble in Sargent, Pl. Wilson. **2**: 78. 1914; Chun, Contr. Biol. Lab. Sci. Soc. China **1**[5]: 61. 1925; Liou, Laurac. Chine Indoch. 191. 1932.

Distribution: China (Szechuan).

China. szechuan: *E. H. Wilson 3694; Veitch Exped. 4422, 4422a* (syntypes, Kew; isotypes, AA); *W. P. Fang 2292, 2297, 2526; F. T. Wang 20579.*

The species is recognized at once by the tawny brown velutinous under surface of the obovate to oval leaves. The petioles are long, and the branches are minutely pubescent. The inflorescence consists of pedunculate axillary umbels, topped with shallow crenulate discs which subtend the ellipsoid fruit (1 cm. × 6–7 mm.).

38. **Litsea Garrettii** Gamble, Kew Bull. 1913: 204; Liou, Laurac. Chine Indoch. 196. 1932.

Distribution: Siam and China.

Siam: *H. B. G. Garrett 63* (syntype, Kew); *A. F. G. Kerr 880* (syntype, Kew); *A. F. G. Kerr 2541, 2602* (syntype not seen, Kew).

China. yunnan: *A. Henry 11649, 11649 D, E, F, G, H, I; J. F. Rock 2661; H. T. Tsai 53253.*

The species is characterized by a racemose inflorescence and elliptic leaves approximately 12 cm. long, very long-attenuate, acuminate, with a tendency towards caudate, slightly falcate tips.

38a. **Litsea Garrettii** Gamble var. **longistaminata** Liou, Laurac. Chine Indoch. 196. 1932.

Distribution: China (Yunnan).

China. yunnan: *A. Henry 12802, 12769* (syntypes, Paris; isotypes, AA); *J. F. Rock 2595?*

A variety which has in common with *L. Dunniana* Lévl. long-exserted stamens. No fruiting specimen has thus far been reported. *Rock no. 2595* has been questionably placed here. The

specimen is glabrescent and in very young fruiting stage. It is too immature, however, for the basis of a complete description of the fruit.

39. **Litsea acutivena** Hay. Ic. Pl. Formos. **5**: 163, fig. 58d. 1915; Kaneh. Formosan Trees, 439. 1917; Ouchi, Sylvia **3**: 142, pl. 4, fig. 3. 1932; Merr. Lingnan Sci. Jour. **15**: 418. 1936.

DISTRIBUTION: Formosa, southern China and Indo-China.

FORMOSA: *B. Hayata & S. Sasaki,* Mt. Arisan, Jan. 1912 (type not seen, Tokyo Herb.).

CHINA. HAINAN: *F. C. How 73416; C. Wang 33352.*—KWANGTUNG: *C. Ford,* Hongkong (as *Lindera bifaria* Benth.); *W. T. Tsang 21455.*—KWANGSI: *W. T. Tsang 22758.*

FRENCH INDO-CHINA. LAOS: *E. Poilane 15688.*

The leaves of this *Litsea* are lanceolate, oblanceolate or oblong-lanceolate, about 12 cm. long and 3.5 cm. broad, glabrous above and pubescent below. The venation is very prominent on the lower surface. The specimen from Laos has larger leaves, but in other respects agrees with the Chinese material.

40. **Litsea Kobuskiana** Allen, Jour. Arnold Arb. **18**: 290. 1937, nom. nov.

Litsea Esquirolii (Lévl.) Allen, Jour. Arnold Arb. **17**: 329. 1936.

Eurya Esquirolii Lévl. Fl. Kouy-Tchéou, 415. 1915, nomen nudum.

Neolitsea spec. Rehd. Jour. Arnold Arb. **10**: 193. 1929.

Litsea Faberi Hemsl. var. *ganchouensis* Liou, Laurac. Chine Indoch. 187. 1932, syn. nov.

DISTRIBUTION: western China.

CHINA. KWEICHOW: Gan chouen, *J. Cavalerie (Esquirol?) 3893,* in 1912 (type of *Eurya Esquirolii,* Edinburgh; isotype AA, and also type of *Litsea Faberi ganchouensis* Liou, Paris).—SZECHUAN: *C. Bock & A. von Rosthorn 276* (sterile specimen but probably belongs here).

This is characterized by oblong-lanceolate, attenuately acuminate leaves 7–10 cm. long and over 2 cm. broad, glabrous and shining above, slightly puberulous below. The leaves are penninerved and coarsely reticulate. The branchlets and petioles are pubescent, gradually becoming puberulous. The specimen of *Eurya Esquirolii* Lévl. in the Léveillé Herbarium collected in Gan chouen under the number *3893,* was without collector's name. It was supposed, since the label was similar to those frequently used by Esquirol and since Léveillé named it

after Esquirol, that the latter was the collector. Cavalerie's name, however, was on the Paris specimen as evidenced by an examination of the type of Liou's variety of *Litsea Faberi* Hemsl. The leaf shape of the latter species is similar to that of *Cavalerie 3893,* but there the similarity ends. They differ in pubescence of the leaves, in their venation and reticulation. The name *Litsea Esquirolii* (Lévl.) Allen goes to synonymy because it is preoccupied. (See "Excluded Species.")

The species is named in honor of Dr. C. E. Kobuski, Assistant Curator of the Arnold Arboretum, who has made an intensive study of the genus *Eurya.*

41. **Litsea Faberi** Hemsl. Jour. Linn. Soc. Bot. **26**: 381. 1891; Chun, Contr. Biol. Lab. Sci. Soc. China, **1**[5]: 63. 1925; Liou, Laurac. Chine Indoch. 187. 1932.

DISTRIBUTION: China (Szechuan and Kiangsi).

CHINA. SZECHUAN: *E. Faber 341* (type, Kew; isotype, AA).—KIANGSI: *C. Y. Hwang 12* (AA).

A species very similar to *Litsea Kobuskiana,* but separated at once by the presence of more numerous pairs of veins deeply impressed on the upper surface, and also by the absence of obvious reticulations.

42. **Litsea elongata** (Wall. ex Nees) Benth. & Hook. f. Gen. Pl. **3**: 163 (in nota sub *Lindera).* 1880; Hook. f. Fl. Brit. Ind. **5**: 165. 1886; Chun, Contr. Biol. Lab. Sci. Soc. China, **1**[5]: 62. 1925; Liou, Laurac. Chine Indoch. 195. 1932; Merr. Lingnan Sci. Jour. **15**: 418. 1936.

Tetranthera elongata Wall. List. No. 2546. 1830, nomen nudum.
Daphnidium elongatum Nees in Wall. Pl. As. Rar. **2**: 63. 1831.

DISTRIBUTION: India to China and Tibet.

INDIA. NEPAL: *N. Wallich 2546* (isotype, Kew, see footnote p. 370).

CHINA. SZECHUAN: *F. T. Wang 22706, 23495.*—KWEICHOW: *W. Y. Chun 6433; A. N. Steward, C. Y. Chiao & H. C. Cheo 430.*—HUPEH: *H. C. Chow 1254.*—HUNAN: *H. Handel-Mazzetti 11152.*—ANHWEI: *R. C. Ching 2935.*

This species has been confused with *Litsea Faberi* Hemsl. from Kwangtung, from which it is distinguished by the elongated oblong-lanceolate or oblanceolate penninerved leaves,

acuminate, pubescent below; and the ellipsoid apiculate pedunculate fruit 10 mm. × 6 mm.

42a. **Litsea elongata** (Wall. ex Nees) Benth. & Hook. f. var. **cuneifolia** Liou, Laurac. Chine Indoch. 195. 1932.

DISTRIBUTION: known only from type locality.

FRENCH INDO-CHINA. TONKIN: *E. Poilane 12809* (type, Paris).

The variety is unusual in its almost complete lack of pubescence on the branchlets and leaves; the uniform shape of the latter; and the subsessile umbels.

43. **Litsea hupehana** Hemsl. Jour. Linn. Soc. Bot. **26**: 382. 1891; Chun, Contr. Biol. Lab. Sci. Soc. China, **1**^{5}: 64. 1925; Liou, Laurac. Chine Indoch. 178. 1932.

DISTRIBUTION: known only from type locality.

CHINA. HUPEH: *A. Henry 6607, 6660* (syntypes, Kew; isotypes, Gray).

A species with crowded alternate leaves which are oblong-elliptic, glabrous above, glaucous below, the midrib reddish yellow, numerous pairs of slender nerves scarcely ascending, inconspicuous above and below. The type material which I have consists of staminate specimens in the early flowering stage. It is too soon to tell whether or not the bracts are caducous. However, there seems to be a strong resemblance to the genus *Actinodaphne*. (See *Actinodaphne Lecomtei* Allen for discussion in detail.)

44. **Litsea Dunniana** Lévl. Fedde, Rep. Spec. Nov. **9**: 460. 1911; Fl. Kouy-Tchéou, 220. 1914; Allen, Jour. Arnold Arb. **17**: 329. 1936.

Neolitsea spec. Rehd. Jour. Arnold Arb. 10: 193. 1929.

DISTRIBUTION: known only from type locality.

CHINA. KWEICHOW: *J. Esquirol 565* (type of *Litsea Dunniana*, Paris; photo. and fragm., AA).

The species is characterized by the sessile inflorescence and long-exserted stamens; the large penninerved oblong-lanceolate leaves, the lower surface of which is covered with long slightly villous hairs. Attention has already been drawn to the similarity of *L. Dunniana* Lévl. to *L. Garrettii* Gamble var. *longistaminata* Liou. (See Allen, l.c.)

45. **Litsea mekongensis** Lecomte, Nouv. Arch. Mus. Hist. Nat. Paris, sér. V, **5**: 84. 1913; Fl. Gén. Indoch. **5**: 134. 1914; Liou, Laurac. Chine Indoch. 190. 1932.

DISTRIBUTION: known only from type locality.

FRENCH INDO-CHINA. LAOS: Mekong, *M. C. Thorel*, in 1866–68 (type, Paris).

This species is very distinctive in having large lanceolate-elliptic leaves 25–30 cm. long, acute or sub-acuminate, glabrous above except the midrib, fulvo-pubescent on veins below. The branchlets are also pubescent.

46. **Litsea viridis** Liou, Laurac. Chine Indoch. 188, fig. 14. 1932.

DISTRIBUTION: French Indo-China.

FRENCH INDO-CHINA. ANNAM: *E. Poilane 1466* (type, Paris).

An unusual species with pale dull leaves prominently reticulate above and glabrescent below; with very large glands surrounding the filament, and with mucronate anthers which are often atrophied.

46a. **Litsea viridis** Liou var. **Clemensii** Liou, Laurac. Chine Indoch. 190. 1932.

DISTRIBUTION: French Indo-China.

FRENCH INDO-CHINA. ANNAM: *J. & M. S. Clemens 3893* (type, Paris; isotype, AA); *E. Poilane 6989* (young fruiting specimen).

The leaves of the variety are larger than those of the species, more attenuate-acuminate and oval-elliptic, the petiole longer and thicker. The fruiting inflorescence consists of two (sometimes three) fruits practically sessile on the common peduncle; the peduncles are numerous and in fasciculate arrangement; the fruits are oblong-apiculate, borne loosely in shallow somewhat fluted cupules, nearly disc-shaped.

47. **Litsea iteodaphne** (Nees) Hook. f. Fl. Brit. Ind. **5**: 173. 1886.

Tetranthera iteodaphne Nees, Syst. Laurin. 542. 1836; Thwaites, Enum. Ceylon Pl. 255. 1861.

DISTRIBUTION: Ceylon and French Indo-China.

CEYLON: *G. H. K. Thwaites 10* (type of *Tetranthera iteodaphne* not seen, Berlin (?); isotype, Gray); *G. H. K. Thwaites 351, 729, 2487.*

FRENCH INDO-CHINA. ANNAM: *E. Poilane 23670, 21826, 21858.*—LAOS: *E. Poilane 26323.*

47a. **Litsea iteodaphne** (Nees) Hook. f., f. **chinensis,** f. nov.
A typo differt foliis variabilibus, subacuminatis, venis reticulationibusque inconspicuis, et inflorescentia breviore.

DISTRIBUTION: China.

CHINA. KWANGSI: *W. T. Tsang 22551* (type, AA).—HAINAN: *F. C. How 73779, 72016, 72151, 72216, 72503.*

The variety differs from the species in that the leaves are subacuminate, the venation and reticulation very inconspicuous, and the inflorescence shorter. The specimens from Hainan are variable in the size of the leaves. In fact, these have been confused with *Litsea variabilis,* from which they differ in leaf shape and reticulation. The latter has oblanceolate obtuse leaves as opposed to the usually oblong-linear acute or subacuminate leaves found in *L. iteodaphne* and its variety. *Litsea variabilis* has very prominently reticulated leaves, whereas in *L. iteodaphne* the reticulation is obscure. The branches of *L. variabilis* are puberulous; those of *L. iteodaphne* are usually, though not always, glabrous at maturity.

48. **Litsea variabilis** Hemsl. Jour. Linn. Soc. Bot. **26**: 386. 1891; Liou, Laurac. Chine Indoch. 188. 1932.

DISTRIBUTION: French Indo-China and China.

CHINA. HAINAN: *A. Henry 4, 8540, 8729* (syntypes, Kew), *8431* (syntype, Kew; isotype, Gray); *W. T. Tsang 140, 174, 87, 325, 482, 506, 507, 707; C. Wang 33169, 33272; H. Y. Liang 62156, 61717, 61516, 61565, 62742, 63093, 64294; S. K. Lau 332, 122, 1009, 1389, 1411, 1455, 1801, 2871, 3549; F. C. How 71050; H. Fung 20145; F. C. How & N. K. Chun 70099, 70261, 70155,* etc.

A species with great variability in leaf shape and thickness of petiole. The leaf varies from oblanceolate to broadly ovate, acutish to obtuse to emarginate. The leaves are prominently reticulate and the branches greyish puberulous.

48a. **Litsea variabilis** Hemsl. var. **oblonga** Lecomte, Nouv. Arch. Mus. Hist. Nat. Paris, sér. V. **5**: 90. 1913.

Litsea variabilis Hemsl. var. *tonkinensis* Lecomte, Fl. Gén. Indoch. **5**: 136. 1914, syn. nov.

DISTRIBUTION: French Indo-China.

French Indo-China. tonkin: *B. Balansa 2404, 2407* (syntypes of *Litsea variabilis* var. *oblonga*, Paris).

The variety has more graceful branches, more membranaceous leaves, not as variable as the species proper, but elliptic, acute to subacuminate, with the reticulations less obvious.

The variety *oblonga* was described in 1913, with the following numbers cited, collected by Balansa: *Nos. 2402, 2403, 2404, 2405, 2406* and *2407*. The herbarium specimens of *Nos. 2404, 2405* and *2407* (the only ones at present available) have the varietal name *oblongifolia* Lecomte written in and crossed out, var. *tonkinensis* replacing it. It would seem that Lecomte had forgotten his earlier name or disregarded it entirely. Of the three numbers at hand, *Nos. 2404* and *2407* are the same. They show an affinity for *L. variabilis* proper and doubtless represent the typical Indochinese variety. *Number 2405,* however, has no connection with *Litsea variabilis* but seems rather to be near *Litsea chartacea.* Until the remaining numbers cited by Lecomte are seen, no attempt at placing *No. 2405* will be made.

49. **Litsea Greenmaniana,** spec. nov.

Arbor circa 6 m. alta, ramulis teretibus rubro-brunneis leviter striatis gracilioribus ex glabrescentibus glabris. Folia alterna, leviter membranacea, elliptica vel suboblanceolata, 7–11 cm. longa, 2.2–3.5 cm. lata, acuminata, saepe falcata, ad basin acuta, pallide viridia, concoloria, supra nitida, subtus opaca, glabra, bene reticulata, penninervia, nervis circiter 10-jugis utrinque prominulis, subtus crassioribus, petiolis 8–15 mm. longis glabrescentibus et brunnescentibus. Subumbellae in quaque inflorescentia 1–4, pedunculatae, pauciflorae, pedunculis 2–3 mm. longis. Flores pubescentes: ♂ perianthii tubo brevissimo, lobis 6 ellipticis, staminibus 9, filamentis pubescentibus. Flores ♀ ex anthesi fere peracta, haud eruendi. Fructus immaturus, cupula pedicelloque dense pubescentibus.

Distribution: southeastern China.

China. kwangtung: *W. T. Tsang 21102* (type, AA), *21229; H. Fung A542 (18947).*—kiangsi: *S. K. Lau 4754.*—fukien: *J. L. Gressitt 1687.*

The unusual feature of this species is the very conspicuous reticulation and the shining upper-surface of the leaves, the

combination giving a viscid appearance. The reddish appearance of the branchlets, and at times the veins, is a distinguishing characteristic. The ♀ flowers are rather far advanced to have retained any characters valuable for diagnosis. The species is named for Dr. J. M. Greenman, Curator of the Herbarium at Missouri Botanical Garden, to whom this paper is dedicated.

50. **Litsea lancifolia** (Roxb.) Benth. & Hook. f. ex F.-Villar in Blanco, Fl. Filip. ed. 3, **4**: (Nov. App.) 181. 1880 (based on *Tetranthera lancifolia* Roxb.); Hook. f. Fl. Brit. Ind. **5**: 159. 1886 (based on *T. lancifolia* Roxb., Wallich List No. 2532, excl. W. Griffith's spec.); Hemsl. Jour. Linn. Soc. Bot. **26**: 382. 1891 (pro parte); Lecomte, Nouv. Arch. Mus. Hist. Nat. Paris, sér. V. **5**: 90. 1913; Fl. Gén. Indoch. **5**: 134. 1914.

Tetranthera lanceofolia Roxb. Hort. Bengal. 73. 1814, nomen nudum.

Tetranthera lancifolia Roxb. ex Wall. List No. 2532. 1830, nomen nudum; ex Nees in Wall. Pl. As. Rar. **2**: 65. 1831; Miq. Fl. Ind. Bat. 1^1: 944. 1858.

DISTRIBUTION: India to China, and reputedly Sumatra.

INDIA. SILHET: *N. Wallich 2532* (isotype of *Tetranthera lancifolia*, Kew, Gray, see footnote p. 370).

CHINA. HAINAN: *F. C. How 73261.*

Litsea lancifolia has elliptic, acute or acuminate leaves approximately 10 × 3 cm., membranaceous, penninerved, glabrescent above, glaucous and softly pubescent below. The branches are ferrugineous-tomentose. The above name was originally given by Roxburgh to *Tetranthera* as a *nomen nudum* in his 'Hort. Bengal.' in 1814. Wallich's 'List,' No. 2532 was first associated with a description by Nees in Wallich, 'Pl. As. Rar.' in 1831. Miquel in 1858 draws attention to the fact that the two plants are not the same. He treats Wallich's specimen as *T. lancifolia* F.-Villar and accepts his determination. Hemsley includes *Actinodaphne lancifolia* and its attending synonymy under *Litsea lancifolia* F.-Villar. Bentham and Hooker f. did not use this binomial in the 'Genera Plantarum.' Thus the combination must be cited as above. The species is supposedly found in Sumatra, but the latter material does not conform to the type material. It is rather nearer its variety *borneensis* (Meissn.) Boerl.

50a. **Litsea lancifolia** (Roxb.) Benth. & Hook. f. ex F.-Villar var. **pedicellata** Hook. f. Fl. Brit. Ind. **5**: 159. 1886.

DISTRIBUTION: India and China.

INDIA. TENASSERIM OR ANDAMAN ISLANDS: *Helfer, Kew Distrib. No. 4306* (type, Kew; isotype, Gray).

CHINA. YUNNAN: *A. Henry 10759, 11143, 12301 A-C, 12235; H. T. Tsai 55301, 55330, 60286, 60337, 60520, 62133.*

The specimens from Yunnan all seem to be the variety rather than the species in that they are more glabrous and have the very slender, longer peduncles of the type of the former. Actually, the varietal name is a misnomer. The peduncles of the umbels are very apparent, and it is evidently this fact that Hooker had in mind in naming the variety.

51. **Litsea Balansae** Lecomte, Fl. Gén. Indoch. **5**: 135. 1914; Liou, Laurac. Chine Indoch. 191. 1932.

DISTRIBUTION: known only from type locality.

FRENCH INDO-CHINA. TONKIN: *B. Balansa 3196* (type not seen, Paris; photo., AA).

Litsea Balansae is a small-leaved species with leaves less than 8 cm. long and under 3 cm. broad, glabrous above, pubescent below, and penninerved with 6–7 pairs of nerves more prominent on the lower surface than on the upper. This species was described from a ♀ specimen only. Liou has placed it in the same group with *Litsea umbellata* (Lour.) Merr. Until more material is collected and further study made, no definite disposition of the species can be proposed. It is very probable that the plant may be a *Lindera*. The photograph shows the habit to be similar to that of *Lindera laureola* Coll. & Hemsl.

52. **Litsea umbellata** (Lour.) Merr. Philip. Jour. Sci. Bot. **14**: 242. 1919; Trans. Am. Philos. Soc. n.ser. **24**^{2}: 167 (Comm. Loureiro Fl. Cochinch.). 1935.

Hexanthus umbellatus Lour. Fl. Cochinch. 196. 1790; ed. 2. 242. 1793; Moore, Jour. Bot. **53**: 254. 1925.

Litsea hexantha Juss. Ann. Mus. Hist. Nat. Paris, **6**: 212. 1805 (based on *Hexanthus umbellatus* Lour.).

Tetranthera ferruginea R. Br. Prodr. 403. 1810, pp. *quoad syn.* Lour.

Litsea amara Bl. Bijdr. 563. 1825; Lecomte, Fl. Gén. Indoch. **5**: 136. 1914; Liou, Laurac. Chine Indoch. 190. 1932.

Tetranthera amara Nees, Syst. Laurin. 551. 1836.

DISTRIBUTION: India and French Indo-China to China, Sumatra, Java and Borneo.

JAVA. (type of *Litsea amara* not seen, Herb. Leiden.)

FRENCH INDO-CHINA. ANNAM: Hue, *J. Loureiro* (type of *Hexanthus umbellatus* not seen, Brit. Mus.); *J. & M. S. Clemens 3169; E. Poilane 22273.*—TONKIN: *P. Eberhardt 3969.*—LAOS: *E. Poilane 20545.*—CAMBODIA: *Bejèaud 83.*—COCHINCHINA: *E. Poilane 19571.*

CHINA. KWANGSI: *W. T. Tsang 21836.*

Usually *Litsea umbellata* is recognized by the oblong-oval or elliptic leaves, apiculate or acuminate, and covered on the lower surface with red-brown tomentum, in contrast to the bright green upper surface (usually discernible even in the dried specimens). Since this species is polymorphic, the numerous varieties of Meissner and Hooker are not treated. It is possible that some of these, though described from the Islands and the Malay Peninsula, may be found in Indochina. The variation within the species is so great, however, and the species so easily distinguished, that no attempt will be made here to separate them.

DOUBTFUL SPECIES

Litsea salicifolia (Roxb.) Hook. f. Fl. Brit. Ind. **5**: 167. 1886; Liou, Laurac. Chine Indoch. 180. 1932.

Tetranthera salicifolia Roxb. ex Wall. List No. 2536A, pp., B, C. 1830, nomen nudum; ex Nees in Wall. Pl. As. Rar. **2**: 66. 1831.

DISTRIBUTION: India, and possibly French Indo-China. Liou cites the species as occurring in Tibet.

INDIA: *N. Wallich 2536A*, ex parte, *B, C,* (isotype of *Tetranthera salicifolia* not seen, Kew, see footnote p. 370).

The species is characterized by oblong-elliptic leaves 11–20 cm. long, 2.5–5.5 cm. broad, and ellipsoid fruit 10–11 mm. long.

Litsea salicifolia (Roxb.) Hook. f. var. **attenuata** (Meissn.) Hook. f. Fl. Brit. Ind. **5**: 168. 1886.

Tetranthera glauca var. *attenuata* Meissn. in DC. Prodr. **15**[1]: 185. 1864.

Tetranthera attenuata Wall. List No. 2534. 1830, nomen nudum; ex Nees in Wall. Pl. As. Rar. **2**: 66. 1831.

DISTRIBUTION: India and Tibet.

INDIA. SILHET: *N. Wallich 2534* (isotype of *Tetranthera attenuata*, Kew, NY, see footnote p. 370).

Nees, in Wallich, 'Pl. As. Rar.' **2**: 66–7. 1831, described *Tetranthera glauca, T. salicifolia* and *T. saligna* as species. *T. saligna* is based on *T. angustifolia* Wallich, 'List,' but the name is changed to *saligna* because *Litsea angustifolium* Blume has already been described. Meissner, in DC. 'Prodromus' **15**[1]: 183, 185. 1864, recognizes *T. angustifolia* and *T. glauca, T. saligna* in part being in synonymy under *T. angustifolia,* and in part being a variety of *T. glauca. T. salicifolia* is split up under the several varieties of *T. glauca.* Hooker, also, recognizes the same *T. glauca,* but transfers it to *Litsea.* However, Hooker retains the specific name of *salicifolia* under *Litsea,* keeping the same varieties under the latter species that Meissner had under *T. glauca.* Having at hand no type of *T. salicifolia* proper or of *T. angustifolia* and only two of the varieties under *T. glauca,* the synonymy cannot at present be straightened out. It remains to wait until the Indian types of all are available, before such an attempt is made. Liou reports the species *L. salicifolia* as occurring in Tibet, hence its inclusion in the present treatment. I have not seen any material outside of India that I would place in the species.

Litsea salicifolia (Roxb.) Hook. f. f. **glabra** (Liou), comb. nov.

Litsea polyantha Jussieu *f. glabra* Liou, Laurac. Chine Indoch. 193. 1932.

DISTRIBUTION: China (Hainan).

CHINA. HAINAN: *W. T. Tsang & H. Fung 634* (type of *Litsea polyantha glabra,* Paris; isotype, AA); *F. C. How 72093, 72537, 72739.*

Since *Litsea salicifolia,* though its status is as yet uncertain, obviously is the nearest relative of the f. *glabra* of Liou, the above combination has been made to denote the position of the latter in the genus.

EXCLUDED SPECIES AND VARIETIES

Litsea aurata Hay. Jour. Coll. Sci. Tokyo, **30**: 246 (Mater. Fl. Formosa). 1911 = **Neolitsea aurata** (Hay.) Merr.

Litsea Cavaleriei Lévl. in Fedde. Rep. Spec. Nov. **10**: 371, 1912 = **Lindera communis** Hemsl.

Litsea Chaffanjoni Lévl. in Fedde, Rep. Spec. Nov. **12**: 182. 1913 = **Symplocos stellaris** Brand.

Litsea confertifolia Hemsl. Jour. Linn. Soc. Bot. **26**: 379. 1891 = **Neolitsea confertifolia** (Hemsl.) Merr.

Litsea consimilis Nees, Syst. Laurin. 628. 1836 = **Neolitsea umbrosa** (Wall.) Gamble.

Litsea coreana Lévl. in Fedde, Rep. Spec. Nov. **10**: 370. 1912 = **Machilus Thunbergii** Sieb. & Zucc.

Litsea cupularis Hemsl. Jour. Linn. Soc. Bot. **26**: 380. 1891 = **Actinodaphne cupularis** (Hemsl.) Gamble.

Litsea Esquirolii Lévl. in Fedde, Rep. Spec. Nov. **9**: 459. 1911 = **Lindera communis** Hemsl.

Litsea fruticosa Gamble[1] = **Lindera fruticosa** Hemsl.

Litsea glauca Sieb. Verh. Bat. Genoot. **12**: 24. 1830 = **Neolitsea Sieboldii** (O. Ktze.) Nakai.

Litsea gracilipes Hemsl. Jour. Linn. Soc. Bot. **26**: 381. 1891 = **Neolitsea wushanica** (Chun) Merr.

Litsea hupehana Hemsl. var. *longifolia* Lecomte, Nouv. Arch. Mus. Hist. Nat. Paris, sér. V. **5**: 88. 1913 = **Actinodaphne Lecomtei**, spec. nov. (see p. 413).

Litsea laxiflora Hemsl. Jour. Linn. Soc. Bot. **26**: 383. 1891 = **Sassafras Tzumu** Hemsl.

Litsea Mairei Lévl. Cat. Pl. Yun-Nan, 150. 1916 = **Myrica adenophora** Hance.

Litsea myricopsis Lévl. Cat. Pl. Yun-Nan, 150. 1916 = **Myrica esculenta** Ham. ex Don.

Litsea obovata Nees, Syst. Laurin. 636. 1836 = **Actinodaphne obovata** Bl.

[1] **Lindera fruticosa** Hemsl. Jour. Linn. Soc. Bot. **26**: 388. 1891.

Litsea fruticosa Gamble in Sargent, Pl. Wilson. **2**: 77. 1914; Liou, Laurac. Chine Indoch. 171. 1932.

Benzoin fruticosum (Hemsl.) Rehd. Jour. Arnold Arb. **1**: 145. 1919; Chun, Contr. Biol. Lab. Sci. Soc. China, **1**^{5}: 42. 1925.

DISTRIBUTION: China.

CHINA. HUPEH: *A. Henry 4750, 6571* (syntypes, Kew; isotypes, Gray).—HONAN: *J. Hers* for *E. H. Wilson 40,* in 1918 (♂ specimen in AA).

These specimens are fruiting branches and ♀ flowers respectively. Gamble based his new combination on Wilson's *1636, 1659* from Kiangsi, *3670,* and *Veitch 1946* from Hupeh, and *4587* from Szechuan. The *Veitch No. 1946* I have not seen. Numbers *1636, 1659,* and *3670* are fruiting specimens. Number *4587* has ♂ flowers in few-flowered, practically sessile glomerules, and has four-celled anthers, which latter was the basis of Gamble's assumption that the plant was a *Litsea.* But the anther cells, instead of being one pair above the other, are one pair introrse, the second pair laterally extrorse. This number, hence, must be placed in the genus *Neocinnamomum.* Thus the name *Lindera fruticosa* stands. *Hers* for *Wilson Number 40* shows a typical *Lindera* flower with two-celled anthers. The infrutescence of *Lindera fruticosa* is the typical pedunculate umbel with numerous fruits. The fruit of *Neocinnamomum* has the enlarged calyx typical of *Cinnamomum.* Geographically the two are separate, *Neocinnamomum* occurring in the western part of China, and India, and *Lindera fruticosa* found in central and eastern China.

Litsea Playfairii Hemsl.[1] = **Lindera Playfairii** (Hemsl.), comb. nov.

Litsea pulchella Meissn. in DC. Prodr. **15**[1]: 224. 1864 = **Neolitsea pulchella** (Meissn.) Merr.

Litsea shweliensis W. W. Sm. Notes Bot. Gard. Edinb. **13**: 167. 1921 = **Actinodaphne confertiflora** Meissn.

Litsea touyunensis Lévl. in Fedde, Rep. Spec. Nov. **11**: 63. 1912 = **Lindera megaphylla** Hemsl. f. **touyunensis** (Lévl.) Rehd.

Litsea umbrosa Nees, Syst. Laurin. 623. 1836 = **Neolitsea umbrosa (Wall.)** Gamble.

Litsea undulatifolia Lévl. Fl. Kouy-Tchéou, 220. 1914 = **Neolitsea undulatifolia** (Lévl.) Allen.

Litsea wushanica Chun, Jour. Arnold Arb. **9**: 153. 1928 = **Neolitsea wushanica** (Chun) Merr.

Litsea zeylanica Nees, Amoen. Bot. Bonn. fasc. 1: 58, pl. 5 (Cinn. Disput.). 1823 = **Neolitsea zeylanica** (Nees) Merr.

Litsea zeylanica Nees var. *chinensis* Benth. in Hook. f. Jour. Kew Gard. Miscel. **5**: 199. 1853 = **Neolitsea pulchella** (Meissn.) Merr.

KEY TO THE SPECIES OF ACTINODAPHNE

1. Leaves triplinerved.......................................1. *A. confertiflora*
1. Leaves penninerved.
    2. Fruit pubescent.......................................2. *A. trichocarpa*
    2. Fruit glabrous.
        3. Leaves obovate.
            4. Leaves 10 cm. long or less...........................3 *A. magniflora*
            4. Leaves over 10 cm. long.
                5. Fruit globose, 0.4 cm. or less in diam.; inflorescence racemose; leaves 15–20 cm. long.................................4. *A. pilosa*
                5. Fruit elliptic, 2.5 cm. long, 1 cm. broad; inflorescence of numerous umbels; leaves up to 50 cm. long.....................5. *A. obovata*
        3. Leaves never obovate.
            4. Largest leaves less than 10 cm. long.
                5. Fruit subtended by cupules 0.4–0.5 cm. long...........6. *A. cupularis*
                5. Fruit subtended by shallow disc nearly flat.

[1] **Lindera Playfairii** (Hemsl.), comb. nov.

Litsea Playfairii Hemsl. Jour. Linn. Soc. Bot. **26**: 384. 1891.

Neolitsea Playfairii Chun, Contr. Biol. Lab. Sci. Soc. China, **1**[5]: 66. 1925; Merr. Lingnan Sci. Jour. **5**: 81. 1927; Liou, Laurac. Chine Indoch. 145, pl. 1932.

Distribution: China (Kwangtung).

China. kwangtung: *G. M. Playfair* (type, Kew; photo. & fragm., AA).

The original description gives "flowers 6-merous, perianth segments petaloid." Chun, when he made the combination under *Neolitsea,* stated that the flowers were in bud. Dissection shows the typical *Lindera* flowers. It is possible that under *Lindera* this same species has already been described and that only careful study of that genus will reveal it. No fruiting material is described for this species.

6. Leaves obtusish at apex, dull on upper surface (Japan & Formosa) .... 7. *A. lancifolia*
6. Leaves acutish at apex, more shining on upper surface, usually smaller than species (China) .... 7a. *A. lancifolia* var. *sinensis*
4. Largest leaves over 10 cm. long.
5. Inflorescence racemose; cupule densely pubescent .... 8. *A. Henryi*
5. Inflorescence not racemose.
6. Leaves alternate.
7. Young branchlets and lower leaf-surface ferrugineous-tomentose .... 9. *A. ferruginea*
7. Young branchlets, midrib and secondary nerves brown-pubescent; lower leaf-surface glaucous .... 10. *A. litseaefolia*
6. Leaves verticillate or pseudoverticillate.
7. Leaves caudate-acuminate at apex; stamens exserted ... 11. *A. Tsaii*
7. Leaves never caudate-acuminate.
8. Fruit globose.
9. Leaves narrowly lanceolate, up to 50 cm. long .... 12. *A. sesquipedalis*
9a. Leaves smaller, more pubescent .... 12a. *A. sesquipedalis* var. *cambodiana*
9. Leaves not narrowly lanceolate, less than 30 cm. long.
10. Leaves broadly elliptic, dark, and shining above, pale below .... 13. *A. perlucida*
10. Leaves not broadly elliptic.
11. Fruit not more than 1 cm. in diam., not apiculate .... 14. *A. glaucina*
11. Fruit more than 1 cm. in diam., definitely apiculate .... 15. *A. omeiensis*
8. Fruit not globose.
9. Fruit ovoid.
10. Leaves linear or oblong-lanceolate, shining above .... 16. *A. setchuenensis*
10. Leaves elliptic-lanceolate, reticulate above. 17. *A. reticulata*
10a. Leaves entirely glabrous .... 17a. *A. reticulata* var. *glabra*
9. Fruit oblong or obovoid.
10. Numerous pairs of secondary veins, ascending, conspicuous on lower surface; lower surface of leaves light brown, pilose-pubescent, glaucous when young; fruit oblong .... 17b. *A. reticulata* var. *Forrestii*
10. Secondary veins obscure; lower surface of leaves glaucous when young; fruit obovoid .... 18. *A. Lecomtei*

1. **Actinodaphne confertiflora** Meissn. in DC. Prodr. 15^1: 219. 1864; Hook. f. Fl. Brit. Ind. 5: 154. 1886.

Litsea shweliensis W. W. Sm. Notes Bot. Gard. Edinb. **13**: 167. 1921; Liou, Laurac. Chine Indoch. 171. 1932, **syn. nov.**

DISTRIBUTION: India and China.

INDIA. BHUTAN: *W. Griffith 2486* (type of *A. confertiflora* not seen, Kew); E. HIMALAYA: *W. Griffith 4333* (Kew, duplicate, Gray).

CHINA. YUNNAN: Shweli-Salween Divide. *G. Forrest 15705, 17531, 17648, 17697* (syntypes of *L. shweliensis*, Edinburgh; isotypes, AA).

This is a striking species because of its large ovate tripli-nerved leaves (15 × 10 cm.), glabrous, very shining and heavily reticulate above, and paler below.

In Hooker's 'Flora,' the specimen cited under *Actinodaphne confertiflora* is *Griffith* (Kew Distrib. *433*). This undoubtedly should be *4333*, the specimen cited above. Whether or not this is the number *2486* of Griffith, assigned to a different Kew Distribution number, cannot be ascertained without examination of the type in Hooker's Herbarium at Kew. The duplicate sheets of *Griffith No. 4333*, at Gray Herb. and N. Y., both are under the genus *Litsea*, the species being attributed also to Meissner. Since no trace of the publication of this combination has been found, it is presumably an herbarium name only. Therefore, it will not be mentioned in the present treatment. Examination of the specimens shows no reason for the species being considered a *Litsea*.

2. **Actinodaphne trichocarpa**, spec. nov.

Arbor ad 8 m. alta, ramulis teretibus brunneis adpresse pubescentibus, perulis ad basin ramulorum diu persistentibus. Folia in apice ramulorum verticillata, primo membranacea, demum satis coriacea, oblanceolata ad elliptica, 8–13 cm. longa, 2–3 cm. lata, varie acuminata, ad basin acuta vel subrotundata, supra sub lente minute reticulata, pallide viridia, glabra, subtus saepe glaucescentia, adpresse pubescentia glabrescentiave, margine undulata, penninervia, nervis 6–10 (vel pluribus) satis arcuatis, supra inconspicuis subtus satis prominentibus, petiolis 5–8 mm. longis, adpresse pubescentibus. Inflorescentia subumbellata, pauciflora, axillaris, solitaria, subsessilis; Flores ♂ & ♀ ignoti. Fructus globosus, 12–15 mm. latus, brunneus, adpresse tomentosus, disco plano, pedicello satis crasso.

DISTRIBUTION: western China.

CHINA. SZECHUAN: Mt. Omei, *F. T. Wang 23494* (type, AA); same locality

W. P. Fang 3100; Kuan-hsien, *W. P. Fang 1997.*—YUNNAN: Liang-shan, La'mi, *H. T. Tsai 51249.*

This species is unusual for the large pubescent fruit, which is characteristic of all of the specimens cited above. The *Wang* number is less glaucous on the lower leaf surface, and nearly glabrous. The Yunnan plant is also less glaucous, highly pubescent on the young leaves, and the leaves are somewhat larger and more elliptic than those of the Szechuan plants. However, due to the character of the fruit and the persistent bud-scales, these are all united under one species.

3. **Actinodaphne magniflora**, spec. nov.

Arbor 3 m. alta, ramulis teretibus striatis brunneis primo dense tomentosis demum adpresse ferrungineo-pubescentibus. Folia in apice ramulorum subverticillata, subcoriacea, oblanceolato-elliptica, 6–10 cm. longa, 2.5–4 cm. lata, abrupte acuminata, ad basin cuneata, supra sub lente minute reticulata, glabra, subtus ferrugineo-pubescentia, ad marginem leviter revoluta, penninervia, nervis flavis 8–10-jugis subarcuatis, supra immersis subtus prominulis, pubescentibus, petiolis 7–12 mm. longis tomentosis. Inflorescentia axillaris, ex subumbellis numerosis verticillatis confertis, composita, pedunculis 8–10 mm. longis, pubescentibus. Flores 3–5, circa 7 mm. longi, pedicello pubescente, 2–4 mm. longo, perianthii tubo brevissimo, lobis 6, ellipticis extus pubescentibus intus glabris. Flores ♂ staminibus 9, filamentis 5–7 mm. longis, ad basin pubescentibus, staminibus exterioribus 6, interioribus 3 biglandulosis, glandulis breviter stipitatis cordatis, staminodiis triangularibus stipitatis pubescentibus, ovario glabro, stylo filiformi, stigmate subdiscoideo. Flores ♀ fructusque ignoti.

DISTRIBUTION: China.

CHINA. KWANGTUNG: Hongkong, no collector given, *659* (as *Actinodaphne angustifolia).*—KWANGSI: Tou Ngok Shan, along Kwantung border, *W. T. Tsang 23203* (type, AA).

One of the large-flowered species of *Actinodaphne,* distinctive because of its large reddish brown pubescent flowers, borne in a terminal cluster; and because of its obovate, subverticillate leaves, pubescent on the lower surface. This has

been placed in *Actinodaphne* because of the fact that the scales are caducous at anthesis. The Hongkong specimen *No. 659* was labeled *A. angustifolia* Nees, but it differs materially from the latter in pubescence and in inflorescence.

4. **Actinodaphne pilosa** (Lour.) Merr. Trans. Am. Philos. Soc. n.s. **24**^{2}: 165(Comm. Loureiro. Fl. Cochinch.). 1935.

Laurus pilosa Lour. Fl. Cochinch. 253. 1790; ed. 2. 311. 1793.
Machilus pilosa Nees, Syst. Laurin. 176. 1836.
Tetranthera pilosa Sprengel, Syst. **2**: 267. 1825.
Actinodaphne cochinchinensis Meissn. in DC. Prodr. **15**^{1}: 216. 1864; Lecomte, Not. Syst. **2**: 330. 1913; Nouv. Arch. Mus. Hist. Nat. Paris, sér. V. **5**: 92. 1913; Fl. Gén. Indoch. **5**: 128, pl. 4. 1914; Merr. Lingnan Sci. Jour. **9**: 37. 1930; Liou, Laurac. Chine Indoch. 157. 1932.
Machilus hainanensis Merr. Philip. Jour. Sci. **21**: 342. 1922; Lingnan Sci. Jour. **5**: 80. 1927.

DISTRIBUTION: French Indo-China and China.

FRENCH INDO-CHINA. COCHINCHINA: *C. Gaudichaud 1839* (type of *A. cochinchinensis* not seen, Paris); *C. Gaudichaud 286* (cited in Lecomte's emended description, Paris).—ANNAM: *J. Loureiro* (type of *Laurus pilosa* not seen, Brit. Mus.?); *A. Chevalier 41230*.—TONKIN: *A. Petelot 759, 5966.*

CHINA. HAINAN: *F. A. McClure 7957* (type of *Machilus hainanensis*, NY); *7674* (paratype of same, NY; isotype, AA); *F. C. How 71736; C. Wang 34115, 35178, 35748, 36675; S. K. Lau 2930, 2962, 3516; N. K. Chun & C. L. Tso 43655, 44112, 44693; H. Fung 20058; W. T. Tsang 44935; H. Y. Liang 63828, 63829, 63225, 63140, 64081, 64476; S. P. Tang & H. Fung 19149; C. I. Lei 168, 344; F. A. McClure 19731, 19756.*—KWANGSI: *W. T. Tsang 21968; R. C. Ching 7772, 7765.*—YUNNAN: *A. Henry 13588.*

An unusual *Actinodaphne* characterized by large leaves up to 15 cm. or more long, obovate, acuminate, penninerved, shining above, glabrous and pilose below. The branchlets and inflorescence are also densely but closely pubescent. The inflorescence consists of a raceme about 3–4 cm. long; the fruit is globose and small, measuring less than 4 mm. in diam. It is a question whether or not this species so long included in the genus *Actinodaphne* should remain there. The inflorescence and fruiting specimens are certainly not typical of the usual conception of the genus.

5. **Actinodaphne obovata** Bl. Mus. Bot. Lugd.-Bat. **1**: 342. 1851; Meissn. in DC. Prodr. **15**^{1}: 219. 1864; Liou, Laurac. Chine Indoch. 158. 1932.

Tetranthera obovata Hamilt. ex Wall. List No. 2562. 1830.
Tetradenia obovata Nees in Wall. Pl. As. Rar. 2: 64. 1831.
Laurus obovata Hamilt. ex Nees in Wall. l.c.
Litsea obovata Nees, Syst. Laurin. 636. 1836.

DISTRIBUTION: India and China.

INDIA. SILHET: *N. Wallich 2562* (isotype of *Tetranthera obovata*, Kew, see footnote p. 370).

CHINA. YUNNAN: *H. T. Tsai 60884; C. Schneider 3902; G. Forrest 17821.*

This is one of the largest-leaved of the actinodaphnes known, the blade measuring sometimes 50 cm. in length and 25–30 cm. in width. The leaves are striking because of the rich warm-brown pubescence on the nerves, particularly on the under surface where they stand in relief against the extremely glaucous background. The inflorescence is composed of numerous pedunculate 2–3-flowered umbels. The fruit is black, elliptic, up to 2.5 cm. long and about 1 cm. broad, subtended by a flaring disc-like cupule 8–10 mm. long and 2–3 mm. in diameter. In 1911, Hayata[1] described *Litsea obovata* from Formosa. This name, although invalidated by the above publication of Nees, has been accepted in later floristic publications from Japan and Formosa. Makino & Nemoto[2] made the change to *Tetradenia.*

6. **Actinodaphne cupularis** (Hemsl.) Gamble in Sargent, Pl. Wilson. 2: 75. 1914; Chun, Contr. Biol. Lab. Sci. Soc. China, 1^5: 53. 1925.

Litsea cupularis Hemsl. Jour. Linn. Soc. Bot. 26: 380. 1891.

DISTRIBUTION: western and central China.

CHINA. HUPEH: *A. Henry 3473, 3473B, 4382, 4584, 7711, 7750* (syntypes not seen, Kew); *A. Henry 3240, 3473A, 4370* (syntypes, Kew; isotypes, AA); *H. C. Chow 1489, 1543.*—SZECHUAN: *A. Henry 7122* (syntype not seen, Kew); *T. T. Yü 291; F. T. Wang 20683, 23644; W. P. Fang 1276, 1998, 5663, 5747.*—KWEICHOW: *A. N. Steward, C. Y. Chiao & H. C. Cheo 246; Y. Tsiang 6171.*

The leaves of this species are elliptic, acuminate, penninerved, glabrous above, somewhat glaucous and pubescent to glabrescent below. The fruit is ovoid, 12–14 mm. long, distinctly apiculate at the apex, and subtended by a deep more or less rugose cupule.

[1] Hayata, Jour. Coll. Sci. Tokyo, 30: 252. 1911.
[2] Makino & Nemoto, Fl. Jap. ed 2. 375. 1931.

7. **Actinodaphne lancifolia** (Sieb. & Zucc.) Meissn. in DC. Prodr. 15[1]: 211. 1864; Franch. & Sav., Enum. Pl. Jap. 1: 413. 1875.

Daphnidium lancifolium Sieb. & Zucc. Abh. Akad. Wiss. Muench. 4[3]: 207 (Fam. Nat. Fl. Jap. 2: 83). 1846.

Iozoste lancifolia Bl. Mus. Bot. Lugd.-Bat. 1: 364. 1851.

Litsea lancifolia sensu Hemsl. Jour. Linn. Soc. Bot. 26: 382. 1891; Mats. & Hay. Enum. Pl. Formos. 352. 1906, non F.-Villar.

Distribution: Japan and Foromsa.

Japan: (type of *Daphnidium lancifolium* not seen, Leiden).

This species has caused much discussion (see *Litsea rotundifolia* var. *oblongifolia* [Nees] Allen). It has rather small leaves 8–10 cm. long, more elliptic than lanceolate, subacuminate with obtuse acumen, penninerved, glabrous above, glabrescent below. The petioles are glabrescent, and the branchlets glabrescent to glabrous. The inflorescence consists of a solitary subumbel, subsessile. The pedicel is approximately 5 mm. long, topped by a shallow irregular disc with a spread of less than 4 mm. The fruit is subglobose, 6–7 mm. in diameter and apiculate. *Litsea lancifolia* (Roxb.) Benth. & Hook. f. ex. F.-Villar is a true *Litsea,* and has nothing to do with *Actinodaphne lancifolia* (Sieb. & Zucc.) Meissn. *Litsea lancifolia* F.-Vill. was based on the very different *Tetranthera lancifolia* Roxb., not on *Daphnidium (Iozoste) lancifolium* Sieb. & Zucc.

7a. **Actinodaphne lancifolia** (Sieb. & Zucc.) Meissn. var. **sinensis**, var. nov.

A typo differt foliis plerumque minoribus acutis coriaceis saepe glaucinis, fructu pedicellis plerumque brevioribus.

Distribution: eastern and central China.

China. chekiang: *S. Chen 37, 439, 1165, 1258, 1414, 2156* (type, AA), *2415; W. C. Cheng 2146, 3607; R. C. Ching 5004, 5201; Y. Y. Ho 1317, 1627; Y. L. Keng 256.*—kiangsu: *Y. L. Keng 2672, 2682.*—hupeh: *H. C. Chow 1321.*

The leaves of the variety are, for the most part, smaller, more acute at the apex and more shining on the upper surface. In some cases, they are less obviously glaucous. In working over the material of *Litsea rotundifolia* var. *oblongifolia* (Nees) Allen, which was under *Actinodaphne* or *Litsea chinensis* in the herbarium, I found that a goodly portion was not

Litsea rotundifolia oblongifolia, but a species different in leaf shape, petiole length and infrutescence. It resembles *Actinodaphne lancifolia* (Sieb. & Zucc.) Meissn. from Japan, but differs slightly in leaf characters. The infrutescence is similar. Although the difference is slight, I propose the above new variety of the species, because of geographical separation. I have cited all of the specimens of the variety which I have seen, since they are for the most part recent collections which have been misidentified in various herbaria. It will be observed that the majority are from the province of Chekiang.

8. **Actinodaphne Henryi** Gamble, Kew Bull. 1913: 265; Liou, Laurac. Chine Indoch. 157. 1932.

DISTRIBUTION: known only from the two collections cited.
CHINA. YUNNAN: *A. Henry 11799A* (type, Kew; isotype, AA), *11799* (fruiting specimens cited in the additional description of fruit given by Liou, l.c.).

Actinodaphne Henryi is a distinctive species due to the extremely large lanceolate or elliptic penninerved leaves 25–30 cm. long, 6–7 cm. broad, and to the greyish-tan pubescent branchlets. The inflorescence is racemose and is covered completely with a dense golden-brown sericeous pubescence. The cupules are very distinctive in that they are covered with a fine greyish pubescence.

9. **Actinodaphne ferruginea** Liou, Laurac. Chine Indoch. 160. fig. 12. 1932.

DISTRIBUTION: known only from type locality.
FRENCH INDO-CHINA. ANNAM: *E. Poilane 1127* (type, Paris; photo., AA).

The above species is distinguished by alternate elliptic leaves 15 cm. or more long and up to 5 cm. broad, attenuately acuminate at apex and subrotund at the base, penninerved, glabrous shining above, and ferrugineous-tomentose below, particularly on the nerves. The young branchlets and petioles are at first covered with a close ferrugineous tomentum, but finally become glabrescent. "Ferrugineous" is hardly the term that should be used to express the shade of the pubescence on the specimen of the type which I have. It seems hardly red enough to be designated as such. Staminate flowers and fruit are unknown.

The species at first glance appears to be a *Litsea,* but the very definitely caducous bracts place it in *Actinodaphne.*

10. **Actinodaphne (?) litseaefolia,** spec. nov.

Frutex ad 4 m. alta, ramulis teretibus striatis rubescentibus ex adpresse pubescentibus glabris, initio griseis demum brunneis. Folia alterna, elliptica vel oblanceolato-elliptica, acuta vel subacuminata, ad basin attenuate acuta, utrinque sub lente reticulata, 13–18 cm. longa, 5.5–7.5 cm. lata, supra glabra, pallide viridia, nitida (fide collectoris), subtus glaucescentia, pubescentia, penninervia, nervis 10–12 satis arcuatis, supra planis subtus elevatis brunneis, petiolis 10–15 mm. longis, ex pubescentibus glabrescentibus. Inflorescentia multiflora, subumbellata, axillaris, solitaria, brevipedunculata. Flores ♂ immaturi, corollae lobis 6, ellipticis extus pubescentibus intus glabris, staminibus 9, 6 interioribus biglandulosis, filamentis ad basin parce pubescentibus; flores ♀ ignoti. Fructus parvus (immaturus?), oblongus, 5 mm. longus, 3 mm. latus, apiculatus, nigrescens, cupula adpresse pubescente 2 mm. longa 6 mm. lata, pedicello brevi crasso.

DISTRIBUTION: China (Hainan).
CHINA. HAINAN: *F. C. How 73626, 72705* (type, AA), *72550.*

A species that looks very like *Litsea Griffithiana* and *Litsea khasyana,* both from India, but has the ragged irregular cupule surrounding the fruit that is characteristic of *Actinodaphne.*

11. **Actinodaphne Tsaii** Hu, Bull. Fan Mem. Inst. Biol. **5:** 307. 1934: Hu in Hu & Chun, Ic. Pl. Sin. **4:** 9, pl. 159. 1935.

DISTRIBUTION: known only from type locality.
CHINA. YUNNAN: *H. T. Tsai 51907* (type, Fan Mem. Inst. Biol; isotype, AA).

A plant with slender branches and oblanceolate acuminate membranaceous leaves 10–12 cm. long, 2–3 cm. broad, penninerved at their apices. The species recalls *Actinodaphne sikkimensis* from India, but the veins of the latter are more numerous, and less conspicuous as well as less arcuate. Both plants have in common the long-exserted stamens of the ♂ flowers.

12. **Actinodaphne sesquipedalis** Hook. f. & Thoms. ex Meissn. in DC. Prodr. **15**[1]: 216. 1864; Hook. f. Fl. Brit. Ind. **5**: 151. 1886; Gamble, Jour. As. Soc. Bengal, **75**[2]: 113. 1912; Liou, Laurac. Chine Indoch. 158. 1932.

DISTRIBUTION: India and Indo-China?
INDIA. MERGUI: *W. Griffith* (type, Kew).

Except for the type of *Actinodaphne sesquipedalis,* I have seen no material of the species. Liou has recorded one specimen from Annam. It is an interesting plant, having coarse, long narrowly lanceolate, pubescent, penninerved leaves, verticillate, over 50 cm. long and 10 cm. broad. The inflorescence consists of numerous pedunculate umbels, which increase tremendously in size and coarseness in the fruiting stage. The fruit is globose.

12a. **Actinodaphne sesquipedalis** var. **cambodiana** Lecomte, Nouv. Arch. Mus. Hist. Nat. Paris, sér. V. **5**: 93. 1913; Fl. Gén. Indoch. **5**: 130. 1914.

DISTRIBUTION: known only from type locality.
FRENCH INDO-CHINA. CAMBODIA: *L. Pierre 627* (type, Paris).

The leaves of the variety are smaller and more pubescent than those of the species.

13. **Actinodaphne perlucida,** spec. nov.

Arbor 10 m. alta, ramulis teretibus pallide brunneis dense cano-tomentosis mox glabris lucidis. Folia in apice ramulorum verticillata, crasse coriacea, elliptica, abrupte acuta vel obtusa, 11–21 cm. longa, 4–9 cm. lata, primo tomentosa ut videtur, demum nonnisi ad marginem glabrescentia, sicca, supra nitida, sub lente minute reticulata, pubescentia praecipue in nervis, subtus obscure pallida, glabrescentia, penninervia, nervis 7–9-jugis erecto-arcuatis, supra planis subtus prominulis, plerumque nitidis, petiolis crassis, 1–2 cm. longis, 2–3 cm. latis, primo tomentosis mox glabris. Inflorescentia subumbellata, pauciflora, axillaris, solitaria, sessilis. Flores ♂ & ♀ ignoti. Fructus subglobosus, apiculatus, 6–7 mm. in diametro, nigrescens, glaber, cupula brevi irregulariter dentata pubescente, pedicello brevissimo incrassato.

DISTRIBUTION: French Indo-China.

FRENCH INDO-CHINA. ANNAM: *E. Poilane 4590* (type, Paris; photo. and fragm., AA).

An extremely unusual species, placed rather hesitatingly in the genus *Actinodaphne,* because of the character of the cupule. Again, the species is based on fruiting material only, because it is so very distinct. The proper disposition of it cannot be ascertained until staminate specimens are collected. The large penninerved leaves, very darkly shining above and pale below, at once set the species apart. It is evident from the mature specimen that in an early stage the leaves were covered with a dense light tomentum for traces of it are still apparent, particularly on the leaf margins.

14. **Actinodaphne glaucina,** spec. nov.

Arbor ad 10 m. alta, ramulis teretibus striatis ferrugineis adpresse pubescentibus mox glabris, foliorum cicatricibus rotundis haud elevatis. Folia in apice ramulorum subverticillata, ex glabrescentibus glabra, an primo pubescentia, subcoriacea, longe lanceolata, 13–23 (28) cm. longa, 2.5–4 (8) cm. lata, ad apicem acuta vel subacuminata, ad basin attenuate acuta, sub lente supra minute reticulata, subtus ex pallide glaucescentia, penninervia, nervis plerumque 10-jugis subascendentibus flavis, supra conspicuis planis glabrescentibus subtus prominulis ex pubescentibus glabris, petiolis 12–20 mm. longis, ferrugineo-tomentosis. Inflorescentia subumbellata, axillaris, solitaria, pedunculata, pedunculis 2–6 mm. longis, adpresse pubescentibus. Flores ♂ et ♀ ignoti. Fructus globosus, 7–10 mm. latus, nigrescens, disco planiusculo adpresse pubescente, pedicello adpresse pubescente incrassato.

DISTRIBUTION: China (Hainan).

CHINA. HAINAN: Fan Yah, *N. K. Chun & C. L. Tso 44045* (type, AA); *F. C. How 72720* (sterile specimen).

As is frequently the case, the young sterile shoot has larger, coarser leaves, but their type, as well as the characteristic leaf scars, place it with this species. The nearest affinity is *Actinodaphne Henryi* Gamble. Again, more material may show this not to be an *Actinodaphne* but a *Litsea* or a *Neolitsea.* In the

dried state this plant is easily distinguished by contrasting color of the leaf surfaces, the upper being a soft brown, the lower pale green and glaucescent.

15. **Actinodaphne omeiensis** (Liou), spec. nov.

Actinodaphne reticulata Meissn. var. *omeiensis* Liou, Laurac. Chine Indoch. 158. 1932.

DISTRIBUTION: China (Szechuan).

CHINA. SZECHUAN: *W. P. Fang 2448, 2386* (syntypes of *A. reticulata* var. *omeiensis*, Paris; isotypes, AA); *Y. Chen 7206* (syntype of *A. reticulata* var. *omeiensis* not seen, Paris); *F. T. Wang 23212, 23585d; T. T. Yü 402; W. P. Fang 3210.*

This has been raised to specific rank because of the fact that, aside from the leaf shape and its position on the stem, it has no resemblance to *A. reticulata* Meissn. The leaves are coarser, somewhat larger and entirely glabrous, with fewer veins arising from the midrib, salient below. The stem at maturity is maroon in color and glabrous. The fruiting inflorescence is composed of several umbels, consisting of subspherical black fruit about 15 mm. in diameter, very definitely apiculate, subtended by a shallow disc-like cupule, undulate in margin, less than 2 mm. deep, borne on a slender slightly enlarged pedicel, both cupule and pedicel being appressed-pubescent.

16. **Actinodaphne setchuenensis** (Gamble), comb. nov.

Lindera setchuenensis Gamble in Sargent, Pl. Wilson: 2: 82. 1914; Liou, Laurac. Chine Indoch. 128. 1932.

Benzoin setchuenense Rehd. Jour. Arnold Arb. 1: 145. 1919; Chun, Contr. Biol. Lab. Sci. Soc. China, 1[4]: 47. 1925.

DISTRIBUTION: China (Szechuan).

CHINA. SZECHUAN: *E. H. Wilson 4586* (type, AA).

This species was described from a pistillate specimen only. Examination of the type collection shows that the fruit is subtended by a shallow cupule which very distinctly has the remains of the corolla and staminodes about its margin. The leaves are pseudoverticillate, linear-oblong, up to 20 cm. long, about 2.5 cm. broad, penninerved, shining above and pubescent below. The inflorescence consists of pedunculate umbels. The fruit is ovoid, 1 cm. long, subtended by a small irregular shallow cupule about 5 mm. long, borne on a very slender pedicel.

17. **Actinodaphne reticulata** Meissn. in DC. Prodr. **15**[1]: 212. 1864; Hook. f. Fl. Brit. Ind. **5**: 147. 1886; Chun, Contr. Biol. Lab. Sci. Soc. China **1**[5]: 53. 1925; Liou, Laurac. Chine Indoch. 158. 1932.

DISTRIBUTION: India and China?

INDIA. NEPAL: *Herb. Hooker f.* (type, Kew).

Although *Actinodaphne reticulata* Meissn. has been reported from China, the species proper in all probability does not occur there. It is characterized by pubescent verticillate leaves and branchlets. The leaves are very conspicuously reticulate, glabrous above, pubescent below, elliptic (oblong), penninerved and long-acuminate. The fruit is ovoid 10–12 mm. long, 7–8 mm. broad, subtended by a thin shallow cupule, and borne on a slender pedicel.

17a. **Actinodaphne reticulata** Meissn. var. **glabra** Meissn. in DC. Prodr. **15**[1]: 213. 1864; Liou, Laurac. Chine Indoch. 158. 1932.

DISTRIBUTION: India and China.

INDIA. NEPAL?: *Herb. Hooker f.* (type not seen, Kew).

Liou lists this variety as occurring in Yunnan. Hooker f. in the 'Flora of British India' mentions the type of the variety as being a more mature specimen than the type of the species, hence more glabrous. I have seen no representative of the variety except the specimen from Khasya in the Hooker Herbarium, with a fruiting branch nearly as pubescent as the sterile shoot on the sheet beside it. The latter, however, has the remnants of long dark hairs on the under surface of the leaves in addition to the finer lighter pubescence. Although pubescence is at best a variable character and a weak one on which to base a variety, nevertheless, until more material is at hand, the variety will be retained.

17b. **Actinodaphne reticulata** Meissn. var. **Forrestii**, var. nov.

A typo manifeste differt foliis arcte elliptico-lanceolatis, subtus glaucescentibus nervis primo intuito adscendentibus nec arcuatis; indumento pilis adpressis longioribus; cupulis majoribus; pedicellis longioribus; perulis pubescentibus.

DISTRIBUTION: China (Yunnan).

CHINA. YUNNAN: *G. Forrest 18827* ♂ (type, AA), *16047, 17555, 9069; A. Henry 11436, 13323.*

A variety as yet known only from Yunnan, which shows its affinity for *A. reticulata,* but differs in having narrower, longer leaves, glaucous below and covered with light brown pilose pubescence in the young stages. Both characters may or may not persist through the fruiting stage. The branchlets and petioles are covered with a short-appressed dense pubescence, becoming glabrescent in the fruiting stage. The fruiting inflorescence of the variety is larger than that of the species. The fruit is oblong, apiculate, 14–16 mm. long and 6–8 mm. wide, subtended by a cupule 8–10 mm. deep, and borne on a pedicel 15 mm. long.

The variety is named for the late Mr. George Forrest, who collected extensively for a number of years in western China and Tibet.

18. **Actinodaphne Lecomtei,** spec. nov.

Litsea hupehana var. *longifolia* Lecomte, Nouv. Arch. Mus. Hist. Nat. Paris, sér. V. 5: 88. 1913; Liou, Laurac. Chine Indoch. 179. 1932.

Actinodaphne reticulata sensu Gamble, in Sargent, Pl. Wilson. 2: 75. 1914, non Meissn.

Arbor ad 10 m. alta, ramulis teretibus pubescentibus mox glabris. Folia subverticillata vel alternata, membranacea, lanceolata, 10–15 cm. longa, 14–26 mm. lata, acuta vel attenuate acuta, supra opaca, glabra, sub lente minute reticulata, subtus interdum glaucescentia, parce adpresseque pubescentia, sub lente minute reticulata, penninervia, costa valde prominente pallidiore, nervis numerosis supra subtusque inconspicuis, petiolis gracilibus, 7–13 mm. longis, ex adpresse pubescentibus glabris. Inflorescentia subumbellata, axillaris, subsessilis. Flores numerosi, circa 7 mm. longi, pedicello pubescente, 2–3 mm. longo, perianthii tubo brevi, lobis (4)–6, ellipticis laceratis extus pubescentibus subtus glabris. Flores ♂ staminibus 9 (vel pluribus), filamentis gracilibus; staminibus exterioribus 6, 6 mm. longis, interioribus 3.5 mm. longis biglandulosis, glandulis filamentis triplo minoribus breviter stipitatis, ad tertium inferum tubi adnatis; ovario rudimentali.

Flores ♀ ignoti. Fructus obovoideus, circa 7 mm. longus, 5 mm. latus, glaber, viridi-nigrescens, cupula 5 mm. longa, crenulata glabra rugulosa, pedicello 7–8 mm. longo, subincrassato.

DISTRIBUTION: western China.

CHINA. SZECHUAN: Mt. Omei, *E. H. Wilson* (Veitch Exped.) *4424* (type of *Litsea hupehana longifolia* Lecomte, Kew; isotype, AA); *E. H. Wilson* (Veitch Exped.) *5777*; *C. Wang 23250, 23658*; *P. Farges 1474*.—KWEICHOW: *W. Y. Chun 7052*.

DOUBTFUL SPECIES

Actinodaphne Hookeri Meissn. in DC. Prodr. **15**[1]: 218. 1864; Hook. f. Fl. Brit. Ind. **5**: 149. 1886.

DISTRIBUTION: India and China?

INDIA: *Herb. Hooker f.* (type not seen, Kew).

CHINA. YUNNAN: *H. T. Tsai 61952?*

The Yunnan specimen fits the description in the larger sense. It is possible that the Yunnan material represents a variety of the species, and that *A. Hookeri* Meissn. is confined to India.

Actinodaphne pedunculata (Bl.) Meissn. in DC. Prodr. **15**[1]: 211. 1864; Hemsl. Jour. Linn. Soc. Bot. **26**: 383. 1891.

Iozoste pedunculata Bl. Mus. Bot. Lugd.-Bat. 1: 364. 1851.

CHINA: Blume (type of *Iozoste pedunculata* not seen, Leiden; photo., AA).

This species, to judge from the photograph, appears to be a *Machilus*. The species is difficult to determine without the actual material, but if it is *Machilus* it certainly belongs in the group with *Machilus velutina* Champ. and *M. Grijsii* Hance. Superficially it resembles *Actinodaphne magniflora* Allen.

EXCLUDED SPECIES AND VARIETIES

Actinodaphne chinensis Nees, Syst. Laurin. 600. 1836 = **Litsea rotundifolia** Hemsl. var. **oblongifolia** (Nees) Allen.

Actinodaphne chinensis Nees var. *oblongifolia* Nees, Syst. Laurin. 600. 1836 = **Litsea rotundifolia** Hemsl. var. **oblongifolia** (Nees) Allen.

Actinodaphne chinensis Nees var. *rotundifolia* Nees, Syst. Laurin. 600. 1836 = **Litsea rotundifolia** Hemsl.

Actinodaphne confertifolia (Hemsl.) Gamble in Sargent, Pl. Wilson. **2**: 74. 1914 = **Neolitsea confertifolia** (Hemsl.) Merr.

Actinodaphne hongkongensis Chun, Jour. Arnold Arb. **8**: 22. 1927 = **Neolitsea hongkongensis** (Chun) Allen.

Actinodaphne rotundifolia Merr. Lingnan Sci. Jour. **15**: 119. 1936 = **Litsea rotundifolia** Hemsl.

KEY TO THE SPECIES OF NEOLITSEA

1. Leaves penninerved.
  2. Leaf margins undulate; leaves narrowly lanceolate.
    3. Fruit subtended by a scarcely enlarged disc 2 mm. long; pedicel 4 mm. long; largest leaves up to 12 cm. long................1. *N. confertifolia*
    3. Fruit subtended by a shallow cupule 3 mm. deep, 5–6 mm. in diam.; pedicel 7–8 mm. long; largest leaves up to 9 cm. long.............. ....2. *N. undulatifolia*
  2. Leaf margins not undulate.
    3. Young branchlets and leaves ferrugineous-tomentose.
      4. Pubescence of leaf only on petiole and half-way up midrib; leaf oblong, never more than 2.3 cm. broad................3. *N. oblongifolia*
      4. Pubescence of leaf covering entire surface; leaf obovate, obovate-elliptic, never less than 3 cm. broad................4. *N. cambodiana*
        4a. Leaves glabrous, attenuate at base and apex, reticulate.......... ....4a. *N. cambodiana* var. *glabra*
    3. Young branchlets and leaves not ferrugineous-tomentose.
      4. Fruit ovoid; leaves subacuminate with obtuse acumen (Hongkong) ....5. *N. hongkongensis*
      4. Fruit globose; leaves long-acute (Szechuan)............6. *N. wushanica*
1. Leaves triplinerved or obscurely triplinerved.
  2. Leaves obscurely triplinerved.
    3. Leaves caudate, pale; flowers borne in densely crowded subumbels...... ....7. *N. homilantha*
    3. Leaves not caudate; flowers borne in more loosely arranged subumbels.
      4. Leaves glabrous, very coriaceous, extremely obtuse......8. *N. obtusifolia*
      4. Leaves brown-tomentose below, subcoriaceous, subacuminate with obtuse acumen.....................................9. *N. elaeocarpa*
  2. Leaves definitely triplinerved.
    3. Leaves covered below with dense golden or silvery sericeous pubescence.
      4. Leaves ovate-elliptic, obtuse to acute...................10. *N. Sieboldii*
      4. Leaves oblong-lanceolate, falcate-acuminate (Japan & eastern China) ....11. *N. aurata*
        4a. Leaves glabrescent, pubescence colorless (western China)...... ....11a. *N. aurata* var. *glabrescens*
    3. Leaves not covered below with dense golden or silvery sericeous pubescence.
      4. Largest leaves never less than 15 cm. long.
        5. Fruit spherical.
          6. Fruit 10 mm. in diam.; leaves oblong-lanceolate....12. *N. chinensis*
          6. Fruit 15–18 mm. in diam.; leaves ovate.........13. *N. kwangsiensis*
        5. Fruit ellipsoid.
          6. Inflorescence composed of peduncled subumbels; fruit subtended by the very slightly enlarged pedicel tip............14. *N. Levinei*
          6. Inflorescence composed of sessile subumbels; fruit subtended by shallow cupule 2–3 mm. long, 7–8 mm. in diam.......15. *N. Howii*
      4. Largest leaves not more than 13 cm. (occasionally 15 cm. in *N. Chuii*) long.

5. Lower leaf-surface grey-glaucous; veins, petioles and young branchlets ferrugineous tomentose......................16. *N. alongensis*
5. Lower leaf-surface often somewhat glaucous; veins, petioles and young branchlets not ferrugineous-tomentose.
  6. Fruit spherical or subspherical.
    7. Ovary pubescent................................17. *N. Poilanei*
    7. Ovary glabrous.
      8. Leaves ovate to elliptic, obtuse, prominently reticulate; bark aromatic ....18. *N. Merrilliana*
      8. Leaves not ovate to elliptic, nor obtuse, not prominently reticulate; bark not aromatic.
        9. Fruiting pedicel 6–8 mm. long, surrounded by disc 3–4 mm. in diam............................19. *N. umbrosa*
        9. Fruiting pedicel shorter than 6–8 mm.; disc very small.
          10. Lowest pairs of nerves outstanding on lower surface, 2–3 pairs near tip of leaf almost imperceptible.
            11. Branchlets and petioles pubescent......20. *N. pulchella*
            11. Branchlets and petioles glabrous.....................................25a. *N. phanerophlebia* f. *glabra*
          10. Lowest pairs of nerves hardly more prominent than others..............................21. *N. zeylanica*
            10a. Leaves more caudate.....21a. *N. zeylanica* var. *Fangii*
  6. Fruit elliptic.
    7. Ovary pubescent..............................17. *N. Poilanei*
    7. Ovary glabrous.
      8. Fruit not less than 15 mm. long; pedicels enlarged to nearly the diameter of the branchlets..............22. *N. ellipsoidea*
      8. Fruit not more than 8 mm. long; pedicels scarcely enlarged.
        9. Branchlets subverticillate..................23. *N. polycarpa*
        9. Branchlets not subverticillate.
          10. Branchlets and leaves entirely glabrous except for petioles.
            11. Largest leaves not less than 10 cm. long; petioles 20–30 mm. long........................24. *N. Chuii*
            11. Largest leaves not more than 9 cm. long; petioles not more than 15 mm. long...24a. *N. Chuii* f. *annamensis*
          10. Branchlets, leaves and petioles pubescent.......................................25. *N. phanerophlebia*

1. **Neolitsea confertifolia** (Hemsl.) Merr. Lingnan Sci. Jour. 15: 419. 1936.

Actinodaphne confertifolia (Hemsl.) Gamble in Sargent, Pl. Wilson. **2**: 74. 1914; Chun, Contr. Biol. Lab. Sci. Soc. China, 1[5]: 54. 1925; Liou, Laurac. Chine Indoch. 159. 1932.

Litsea confertifolia Hemsl. Jour. Linn. Soc. Bot. **26**: 379, pl. 7. 1891.

DISTRIBUTION: China.

CHINA. HUPEH: *A. Henry 3054, 6007, 7829, 7829A* (syntypes, Kew; isotypes, Gray), *1247, 2202, 2203* (syntypes not seen, Kew); *C. Silvestri 749, 751.*—KWANGTUNG: *C. L. Tso 21140, 20917.*—SZECHUAN: *A. Henry 7197* (syntype, Kew; isotype, Gray).

Most of the specimens of the above species are from central or western China. It is a distinctive species because of the undulate margins of the leaves; the latter are narrow lanceolate, less than 10 cm. long and 2 cm. broad, somewhat similar in appearance to *Neolitsea undulatifolia* (Lévl.) Allen. *Neolitsea confertifolia,* however, has larger, coarser leaves, which are glaucous below. The venation in the two species also differs.

2. **Neolitsea undulatifolia** (Lévl.) Allen, Jour. Arnold Arb. **17**: 328. 1936.

Litsea undulatifolia Lévl. Fl. Kouy-Tchéou, 220. 1914.
Neolitsea spec. Rehd. Jour. Arnold Arb. 10: 193. 1929.

DISTRIBUTION: western China.

CHINA. KWEICHOW: *J. Cavalerie without number,* March 14, 1900 (holotype of *Litsea undulatifolia,* Edinb.; isotype, AA).—YUNNAN: *H. T. Tsai 62499.*

The leaves of the species are verticillate, small (less than 9 cm. long), narrowly elliptic with an undulate margin, penninerved, the midrib very prominent, with numerous pairs of more inconspicuous laterals.

The Tsai specimen recalls in its leaf characters *Neolitsea confertifolia* (Hemsl.) Merr. except for the fact that in the latter the leaves are glaucous beneath. The fruiting inflorescence of *N. undulatifolia* consists of sessile umbels. An individual fruit is borne on an enlarged pubescent pedicel which flares into a shallow, more or less crenulate, somewhat pubescent cupule. The fruit is ovoid-ellipsoid, black, approximately 12 × 8 mm., apiculate, rugose on drying. The young branchlets are appressed-pubescent.

3. **Neolitsea oblongifolia** Merr. & Chun, Sunyatsenia, **2**: 234, pl. 45. 1935.

DISTRIBUTION: China (Hainan).

CHINA. HAINAN: *N. K. Chun & C. L. Tso 44049* (type, NY; isotype, AA), *44337, 43891; F. C. How 73215; H. Y. Liang 63523, 63145, 62798; C. Wang 34692.*

A species easily recognized by its small, slender, pale green, oblong or oblong-lanceolate leaves, less than 10 cm. long and 2 cm. broad.

4. **Neolitsea cambodiana** Lecomte, Not. Syst. **2**: 335. 1913; Fl. Gén. Indoch. **5**: 143. 1914; Liou, Laurac. Chine Indoch. 143. 1932.

Neolitsea ferruginea Merr. Lingnan Sci. Jour. **7**: 305. 1929.

DISTRIBUTION: French Indo-China and China.

FRENCH INDO-CHINA. CAMBODIA: *L. Pierre 5154* (type of *Neolitsea cambodiana*, Paris).

CHINA. KWANGTUNG: *W. Y. Chun 5560* (type of *Neolitsea ferruginea*, NY; isotype, AA); *S. K. Lau 20338; C. L. Tso 21039; W. T. Tsang & K. C. Wong 14480, 14591.*—KIANGSI: *S. K. Lau 4457, 4818.*

The species is delimited by the dense ferrugineous tomentum on the young leaves and branchlets. This tomentum gradually disappears from the leaves with age, the under surface of the leaf blade showing glaucous, the veins being the last to lose their pubescence. There is a great deal of variation in the leaf characters of the species. *Chun 5552,* cited by Merrill in his original publication, has leaves which are more obovate than oblong-elliptic or lanceolate. In the specimen from Cambodia, they are lanceolate and more glaucous than in the Chinese material. In spite of this variation, however, there can be no doubt that these are conspecific.

4a. **Neolitsea cambodiana** Lecomte var. **glabra**, var. nov.

A typo differt ramulis adpresse pubescentibus, foliis magis attenuatis ad basin et in apice glabris concoloribus utrinque reticulatis, petiolis adpresse pubescentibus.

DISTRIBUTION: known only from type locality.

CHINA. KWANGTUNG: *W. T. Tsang 21646* (type, AA).

The salient difference between the variety and the species is found in the leaves; they are more attenuate at the base and apex; are concolorous, glabrous and everywhere reticulate.

5. **Neolitsea hongkongensis** (Chun), comb. nov.

Actinodaphne hongkongensis Chun, Jour. Arnold Arb. **8**: 22. 1927; Contr. Biol. Lab. Sci. Soc. China, 1^{5}: 54. 1925; Liou, Laurac. Chine Indoch. 160. 1932.

Actinodaphne angustifolia sensu Benth. Fl. Hongkong. 293. 1861, non Nees.

DISTRIBUTION: China (Kwangtung).

CHINA. KWANGTUNG: Hongkong, *C. Wilford?* (type of *Actinodaphne angustifolia* sensu Benth., non Nees, Kew; isotype, Gray?); *Herb. Hongkong 4633* (AA).

The species stands out on account of the oblong-lanceolate to elliptic leaves, heavily and coarsely reticulate (not subfoveolate) above and below, brown, glabrous above and very pale brown-pubescent below. The specimen from Gray, cited as possibly the isotype of *Actinodaphne angustifolia* of Bentham, is in fruit. It differs from *Actinodaphne angustifolia* of Nees in its smaller, oblong-lanceolate leaves not glaucous below, and the flat disc subtending the fruit. However, *Hongkong No. 4633,* which matches Wilford's specimen as to leaf structure and other characters, is a ♂ branch with the typical *Neolitsea* flower structure.

6. **Neolitsea wushanica** (Chun) Merr. Sunyatsenia, **3**: 250. 1937.

Litsea wushanica Chun, Jour. Arnold Arb. **9**: 153. 1928.

Litsea gracilipes Hemsl. Jour. Linn. Soc. Bot. **26**: 381. 1891, non Hook. f.; Chun, Contr. Biol. Lab. Sci. Soc. China, **1**[5]: 65. 1925.

Neolitsea gracilipes Liou, Laurac. Chine Indoch. 143, pl. 1932, **syn. nov.**

DISTRIBUTION: China.

CHINA. SZECHUAN: *A. Henry 7113, 7114* (syntypes, Kew; isotypes, Gray).—HUPEH: *A. Henry 2999* (syntype not seen, Kew).

The leaves of this species are 7 cm. or less in length and up to 2.5 cm. broad, elliptic, acute or subacuminate, very pointed at the apex, more or less acuminate at the base, penninerved, dull pale green above and glaucous below. The globose fruit (6–7 mm. in diam.) is borne on the branches in a subumbellate cluster, subtended by a shallow cupule and pedicel somewhat enlarged, their combined lengths nearly 1 cm. The latter gradually distends toward its apex so that the line of demarcation where it joins the cupule is scarcely perceptible.

7. **Neolitsea homilantha,** spec. nov.

Arbor vel frutex, . . . m. alta, glaber, ramulis teretibus striatis brunneis glabris, perulis brunneo-sericeis. Folia in apice ramulorum, subcoriacea, elliptica, 7–10 cm. longa, 2.5–4 cm. lata, subcaudata, ad basin acuta vel subrotundata, glabra, supra minute obscureque reticulata sub lente, pallide viridia,

subtus glauca, margine undulata, penninervia, triplinervia, nervis 4–6-jugis, nervis in jugo infimo oppositis, ad 1 cm. supra laminae basim confluentibus, reliquis subalternatis ad apicem laminae confertioribus flavis supra subtusque planis, petiolis 10–14 mm. longis, glabris rugosis. Inflorescentia subumbellata, conferta, multiflora, axillaris, subsessilis. Flores ♂ pedicello pubescente, 2 mm. longo, corolla 3–4 mm. longa, tubo brevissimo, lobis 4, ovatis extus pubescentibus intus glabris, staminibus 6, antheris magnis, filamentis leviter exsertis ad basin subpubescentibus, 2 interioribus bi-glandulosis, glandulis breviter stipitatis ad basin filamenti adnati. Flores ♀ minores, staminodiis, ovario ovoideo glabrescente, stylo brevi, stigmate sub lente papillis filiformibus instructo. Fructus ignotus.

Distribution: China (Yunnan).
China. yunnan: *G. Forrest 9524* (type, AA), *9540.*

An unusual feature is presented by the horizontal linear scars appearing on the new growth, which extend half-way the circumference of the twig. They occur between the bud-scale scars and the first leaves. Very possibly they are left by the leaves which are fugacious at an early age. The more logical interpretation, however, is that they represent scars left by bud-scales that are persistent during the elongation of the axis, since there seems to be no trace of the buds which are usually found in the axils of leaves.

8. **Neolitsea obtusifolia** Merr. Lingnan Sci. Jour. **14**: 6. 1935.

Distribution: China (Hainan).
China. hainan: *S. K. Lau 607* (type, NY; isotype, AA), *1316; C. Wang 34041, 34181, 34935, 36192; H. Y. Liang 63517, 66489.*

The distinctive feature of this species is the very stiff leathery appearance given by the oblong-oblanceolate or narrowly oblong-ovate leaves. This is a species similar to *N. elaeocarpa* from Indo-China, but with smaller and coarser leaves, which are smoother in texture and more obtuse. The pedicels in the fruiting stage are longer also.

9. **Neolitsea elaeocarpa** Liou, Laurac. Chine Indoch. 144. 1932.

DISTRIBUTION: French Indo-China.

FRENCH INDO-CHINA. ANNAM: *E. Poilane 10980, 1151,* fruiting specimen (syntypes, Paris), *7126* (syntype, Paris; photo. and fragm., AA).

A species which has in common with *Neolitsea obtusifolia,* a semi-triplinerved condition and similar fruiting inflorescences. The young branchlets and the under surface of the leaves of *Neolitsea elaeocarpa* are brown-tomentose, the pubescence persisting on the veins past anthesis, and becoming glabrescent to glabrous at maturity. There is a resemblance between this species and the Indian variety *concolor* of *Litsea zeylanica,* which belongs under *Neolitsea.* The latter differs, however, in being glabrous throughout, and having longer and enlarged funnel-shaped pedicels ending in a flaring disc which supports the somewhat larger fruit. In spite of these differences there is a strong affinity between the two entities.

10. **Neolitsea Sieboldii** (O. Ktze.) Nakai, Bot. Mag. Tokyo, **41**: 520. 1927.

Litsea glauca Siebold, Verh. Bat. Genoot. **12**: 24. 1830, excl. synon.
Malapoenna Sieboldii O. Ktze. Rev. Gen. **2**: 572. 1891.
Tetradenia glauca (Sieb.) Matsumura, Ind. Pl. Jap. **2**[2]: 140. 1912; Makino & Nemoto, Fl. Jap. 933. 1925; ed. 2. 374. 1931.
Neolitsea glauca (Sieb.) Koidz. Bot. Mag. Tokyo, **32**: 257. 1918, excl. synon. *Laurus glauca* Liou, Laurac. Chine Indoch. 148. 1932, excl. synon.
For complete synonymy see Nakai, l. c.

DISTRIBUTION: Japan, Formosa, Korea and eastern China.

JAPAN: *Siebold* (type of *Litsea glauca,* Leiden?; isotype, Gray).

Nakai's new name was necessary, since *Laurus glauca* of Thunberg, the specimen on which the name was based, is a *Symplocos. Neolitsea Sieboldii* is a beautiful species with leaves varying in shape from ovate-obtuse to acute, the under surface covered with closely appressed silky pubescence, silvery tawny or orange-brown. In these respects it resembles *Neolitsea aurata* (Hay.) Merr., the latter, however, having oblong-lanceolate acuminate leaves. *Laurus glauca* as then interpreted by Siebold must be considered the type of Siebold's

species. The material I have seen of the species exclusive of China seems to contain a mixture. A more complete study of the Japanese flora is necessary before it can be said definitely what other elements are included. The specimens from China are uniform, however, and match Siebold's type.

11. **Neolitsea aurata** (Hay.) Merr. Lingnaam Agr. Rev. **4**: 124. 1927.

Litsea aurata Hay. Jour. Coll. Sci. Tokyo, 30: 246 (Mater. Fl. Formosa). 1911.
Tetradenia aurata Hay. Ic. Pl. Formos. 3: 167. 1913; 5: 174, fig. 61c & c'. 1915.

DISTRIBUTION: Formosa and China.

FORMOSA. *K. Miyake*, in Nov. 1899; *G. Nakahara 1045* (syntypes not seen, Taihoku?).

CHINA. KWANGTUNG: *To & Ts'ang 12519; S. K. Lau 2744; S. S. Sin 11513.*—CHEKIANG: *R. C. Ching 2500.*

The species is characterized by the triplinerved oblong-lanceolate leaves, falcate-acuminate, densely reddish or golden brown-pubescent on the lower surface. Merrill has made this combination from a named specimen from Formosa. Undoubtedly, *Litsea aurata* is a *Neolitsea.* However, *No. 12519,* which Merrill cites as the Chinese representative, does not entirely agree with Hayata's description, the inflorescence not being typical, and the leaf-tips being definitely acuminate, falcate and smaller.

11a. **Neolitsea aurata** (Hay.) Merr. var. **glabrescens** Liou, Laurac. Chine Indoch. 149. 1932.

DISTRIBUTION: western China.

CHINA. SZECHUAN: *W. P. Fang 1315, 5640* (syntypes, Paris; isotypes, AA).

The variety shows a close relation to the species, differing only in the glabrescent branchlets and the slightly less pubescent under surface of the leaves. The color of the pubescence is less aureous and more tawny.

12. **Neolitsea chinensis** Chun, Contr. Biol. Lab. Sci. Soc. China, 1[5]: 68. 1925; Liou, Laurac. Chine Indoch. 149. 1932.

Neolitsea lanuginosa Gamble var. *chinensis* Gamble in Sargent, Pl. Wilson. 2: 79. 1914.

DISTRIBUTION: western China.
CHINA. SZECHUAN: *E. H. Wilson 3707* (type, AA); *Veitch Exped. 2266* (syntype not seen, Kew).

This species with large (up to 20 cm.) leaves, triplinerved, oblong-lanceolate, and coriaceous, is very similar to *N. Levinei* Merr. but is easily distinguished by its globose fruit.

13. **Neolitsea kwangsiensis** Liou, Laurac. Chine Indoch. 146. 1932.

DISTRIBUTION: known only from type locality.
CHINA. KWANGSI: *R. C. Ching 7043, 7017* (syntypes, NY).

A striking species on account of the large, ovate or obovate-oblong, glabrous leaves up to 20 cm. long and 10 cm. broad, triplinerved, with conspicuous parallel transverse veins. The long petioles (up to 4 cm.) also add an unusual feature, as well as the large spherical fruit (1.5–1.8 cm. in diam.).

14. **Neolitsea Levinei** Merr. Philip. Jour. Sci. Bot. **13**: 138. 1918; Groff, Lingnan Univ. Sci. Bull. No. **2**: 48. 1930.

Benzoin Levinei (Merr.) Chun ex Liou, Laurac. Chine Indoch. 148. 1932, pro synon.

DISTRIBUTION: China (Kwangtung and Kiangsi).
CHINA. KWANGTUNG: *E. D. Merrill 11071* (type not seen, Herb. Manila); *C. O. Levine 1332* (syntype, Herb. Manila, isotype, AA); *W. T. Tsang 20938, 21498; S. K. Lau 975.*—KIANGSI: *S. K. Lau 4545, 5130.*

This species is easily recognized by its extremely large, obovate-elliptic leaves 25–30 cm. long and up to 9 cm. broad. Liou included this species under *Neolitsea lanuginosa* (Nees) Gamble. The latter, however, has glabrous branchlets, smaller leaves less glaucous on the lower surface; the veins are less conspicuous above, showing as a mere thread, and are more pubescent below, the transverse venation being inconspicuous; the fruits are borne on more slender pedicels. For these reasons, it has seemed advisable to keep the Chinese species apart from the Indian.

The place of the species in *Neolitsea* is not at all assured. The leaves, as Merrill states, are unusually large for the genus, and it is more probable that the plant belongs to *Lindera*. Until ♂ flowers are found it will be left in *Neolitsea*.

15. **Neolitsea Howii**, spec. nov.

Arbor vel frutex . . . m. altus, ramulis teretibus pallide brunneis adpresse pubescentibus canescentibus. Folia in apice ramulorum, coriacea, obovata, 9.5–18 cm. longa, 3.5–7 cm. lata, in acumen abrupte producta, ad basin acuta, supra subtusque sub lente minute reticulata, pallide viridia, glabra, subtus glauca, glabrescentia, triplinervia, nervis in jugo infimo oppositis, ad 1 cm. supra laminae basim confluentibus, reliquis subalternatis ad apicem laminae confertioribus, nervis flavis subtus magis prominentibus quam supra, subtus pubescentibus, nervulis e primo jugo ortis 6–8 arcuatis, ad marginem laminae excurrentibus, petiolis 1–1.5 cm. longis crassis rugosis adpresse pubescentibus. Inflorescentia subumbellata, ad 7-flora, axillaris, sessilis. Flores ♂ et ♀ ignoti. Fructus ellipsoideus, 12 mm. longus, 9 mm. latus, pallide brunneus, glaber, breviter apiculatus, cupula 2–3(4) mm. longa, 7–8 mm. lata, extus rugosa intus pubescente, pedicello 4–5 mm. longo, crasso rugoso.

DISTRIBUTION: China (Hainan).
CHINA. HAINAN: Po-ting, *F. C. How 73402* (type, AA).

The species is distinguished by the large obovate glaucescent leaves and the greyish pubescence of the branchlets. The umbels in fruiting stage show in the center a small undeveloped bud with light, very closely appressed pubescence.

The species is named after the collector of the type specimen.

16. **Neolitsea alongensis** Lecomte, Fl. Gén. Indoch. **5**: 143. 1914; Liou, Laurac. Chine Indoch. 147. 1932.

DISTRIBUTION: French Indo-China.
FRENCH INDO-CHINA. TONKIN: *H. Lecomte & A. Finet 819* (type, Paris).—ANNAM: *E. Poilane 24564.*

The leaves of this species are broadly elliptic or oblong elliptic-obovate, abruptly and very sharply acuminate, coriaceous, triplinerved at base, minutely reticulate, glaucous below and glabrescent on the veins. The difference between the new shoots and the branches of the previous year is so striking

in this species as to deserve comment, since the branches of the type are not young shoots. On the new growth the branches and the surface of the leaves are covered with a light red-brown tomentum, the veins being the last to lose their pubescence on approaching maturity. On the older branches the pubescence has become darker brown, shorter and more closely appressed.

17. **Neolitsea Poilanei** Liou, Laurac. Chine Indoch. 149. 1932.

DISTRIBUTION: known only from type locality.
FRENCH INDO-CHINA. ANNAM: *E. Poilane 18416* (type, Paris).

The species is unusual in the pubescence of the ovary and staminodia, and the presence of large elongated sacs at the base of the glands on the two innermost staminodia. Liou draws attention to the resemblance of this species to *Neolitsea pulchella.* Except for the leaves being of much finer texture, vegetatively *N. Poilanei* is similar to *N. Chuii.*

18. **Neolitsea Merrilliana,** spec. nov.

Neolitsea zeylanica Merr. var. *obovata* Liou, Laurac. Chine Indoch. 153. 1932.

Arbor parva, ramulis teretibus striatis saepe nodulosis brunneis. Folia in apice ramulorum, coriacea, elliptica, 5–7 cm. longa, 2.2–3.5 cm. lata, subacuta, obtusa vel abrupte acuminata, acumine obtuso, ad basin acuta, concoloria, glabra, supra subtusque conspicue reticulata, triplinervia, nervis in jugo infimo oppositis, ad 0.5 cm. supra laminae basim confluentibus, reliquis subalternatis ad apicem laminae confertioribus, petiolis 5–10 mm. longis rugosis, maturis glabris. Inflorescentia subumbellata, axillaris, solitaria, subsessilis. Flores pedicello 2–3 mm. longo, sericeo-pubescente, corolla 6 mm. longa, perianthii tubo brevissimo, lobis 4, ellipticis ciliatis extus pubescentibus intus glabris. Flores ♂ subexserti, staminibus 6, 2 interioribus biglandulosis, glandulis ad basin adnatis subsessilibus, filamentis glabris ad basin pilis penicillatim dispositis; ovario rudimentali. Flores ♀ minores, ovario ovoideo, stigmate patente. Fructus globosus, 6–7 mm. latus, longe apiculatus, rugosus, brunneus, disco minimo plano; pedicello incrassato glabrescente, 5–6 mm. longo.

DISTRIBUTION: French Indo-China.

FRENCH INDO-CHINA. ANNAM: *J. & M. S. Clemens 4225* (type, AA); *A. Chevalier 41202; E. Poilane 7091, 8731* (syntype of *N. zeylanica obovata* not seen, Paris), *5905* (syntype of *N. zeylanica obovata*, Paris; photo., AA), *5935, 5977* (syntype, Paris).—CAMBODIA: *A. Chevalier 35996* (less conspicuous reticulation of leaves).

The variety has been transferred to the species with the attending description, because it fits into a series with the rest of the specimens cited above. The name *obovata* has not been kept because it is not entirely applicable. *Neolitsea Merrilliana* has been placed under *Lindera Myrrha* (Lour.) Merr. and under *Cinnamomum,* presumably because of the very fragrant bark. It differs from the latter, however, in its nearly sessile umbellate inflorescence, and its flower structure. Just what *Lindera Myrrha* is, it is difficult to state with finality, there being no specimen extant of Loureiro's species. Except for the mention of nine stamens in the original description, *Neolitsea Merrilliana* corresponds very well to *Lindera Myrrha.* In fact, Chevalier's specimen was previously determined as the latter. There is a resemblance to several other species of *Neolitsea,* among them *N. elaeocarpa,* from which it is easily distinguished by the broader more obtuse leaves; and also *N. scrobiculata* from India, which has larger and more acuminate leaves.

It is a pleasure to name this species for Dr. E. D. Merrill, Director of the Arnold Arboretum, who for many years has been a keen student of plants of the Orient.

19. **Neolitsea umbrosa** (Wall.) Gamble in Sargent, Pl. Wilson. **2**: 79. 1914; Liou, Laurac. Chine Indoch. 151. 1932.

Tetranthera umbrosa Wall. List No. 2564. 1830, nomen nudum.

Tetradenia umbrosa Nees in Wall. Pl. As. Rar. **2**: 64. 1831, excl. var. β (based on *Tetranthera umbrosa* Wall.).

Tetradenia consimilis Nees, l. c.

Litsea umbrosa Nees, Syst. Laurin. 623. 1836.

Litsea consimilis Nees, l. c. 628 (excl. syn. *Laurus involucrata* Roxb.).

DISTRIBUTION: India (and reported from China).

INDIA. SILHET: *N. Wallich 2564* (isotype of *Tetranthera umbrosa*, Kew, see footnote p. 370); *N. Wallich 2567B* (isotype of *Tetradenia consimilis* not seen, Kew?).

From the material I have seen of *Litsea consimilis,* compared with the type of *N. umbrosa,* the two seem to be distinct species.

The former has larger oblong leaves, more numerous pairs of veins more or less equidistant, the first pair giving the appearance of triplinerves, are stronger and longer than the rest. This is a characteristic of *Laurus involucrata,* which I feel is a synonym of *Litsea consimilis.*

There are no specimens from China which correspond to *Neolitsea umbrosa,* but numerous specimens answering the description of *Litsea consimilis* in eastern China.

Although I feel that these are distinct, I shall avoid making a new combination under *Neolitsea,* but shall keep the synonyms as given above until such time as the type of *L. consimilis* is available.

20. **Neolitsea pulchella** (Meissn.) Merr. Philip. Jour. Sci. Bot. Bot. **13**: 137. 1918; Chun, Contr. Biol. Lab. Sci. Soc. China, 1[5]: 67. 1925; Liou. Laurac. Chine Indoch. 150. 1932.

Litsea pulchella Meissn. in DC. Prodr. 15[1]: 224. 1864.
Litsea Zeylanica var. *Chinensis* Benth. in Hook. f. Jour. Kew Gard. Miscel. **5**: 199. 1853.

Distribution: China (Kwangtung).
China. kwangtung: *J. G. Champion 162* (type of *Litsea pulchella,* Kew!); *J. G. Champion* (type of *Litsea zeylanica* var. *chinensis,* Kew!).

The species has been for many years confused with *N. zeylanica,* from which it is readily distinguished by its smaller leaves, 5 or often 6 cm. long, elliptic, acuminate and much more symmetrical than those of *N. zeylanica.* The nerves of *N. pulchella* are inconspicuous above as compared with those of *N. zeylanica.*

21. **Neolitsea zeylanica** (Nees) Merr. Philip. Jour. Sci. Suppl: 57. 1906; Lecomte, Nouv. Arch. Mus. Hist. Nat. Paris, sér. V. **5**: 94. 1913; Fl. Gén. Indoch. **5**: 142. 1914; Liou, Laurac. Chine Indoch. 152. 1932.

Litsea zeylanica Nees, Amoen. Bot. Bonn. fasc. 1: 58, pl. 5 (Cinn. Disput.). 1823; Bl. Bijdr. 559. 1825; Nees, Syst. Laurin. 626. 1836; Wight, Icon. Pl. 1: pl. 132. 1839; Bl. Mus. Bot. Lugd.-Bat. 1: 346. 1851.
Tetradenia zeylanica Nees in Wall. Pl. As. Rar. **2**: 64. 1831; **3**: 30. 1832.

Distribution: southern Asia through Malaya to Australia.
Ceylon: (type, Herb. Royeni, not seen, Leiden!).

The plant has oblong or elliptic leaves attenuate at the apex, with an obtuse acumen, glaucous below, the costa, petioles and new branchlets yellowish sericeous and very densely appressed tomentose.

21a. **Neolitsea zeylanica** (Nees) Merr. var. **Fangii** Liou, Laurac. Chine Indoch. 154. 1932.

Distribution: China (Szechuan).
China. szechuan: *W. P. Fang 5775* (type, Paris; isotype, AA).

The variety is distinguished from the species proper by the slightly pedunculate inflorescence, and the stamens being variable in number (6–8). Liou suggests that because of the variable number of the stamens the variety is a connecting link between *Neolitsea* and *Litsea*. The flowers which I examined all had six fertile stamens.

22. **Neolitsea ellipsoidea**, spec. nov.
Arbor ad 30 m. alta, ramulis teretibus rugosis glabris primo flavescenti-brunneis. Folia in apice ramulorum, coriacea, elliptica vel late elliptica, 6–10 cm. longa, 2–4.5 cm. lata, acuta vel obtusa, acuminata, ad basin acuta, concoloria, glabra, minute plus minusve reticulata sub lente. Folia triplinervia, nervis in jugo infimo oppositis, ad 1 cm. supra laminae basim confluentibus, reliquis subalternatis ad apicem laminae confertioribus supra subtusque flavescentibus prominulis, petiolis 2–3 cm. longis, glabris flavis longitudinaliter rugosis. Inflorescentia umbellata, 2–5-flora, solitaria, breviter pedunculata, pedunculis 1–2 mm. longis, glabris. Flores pedicello ferrugineo-pubescente 3–4 mm. longo, corolla 4–5 mm. longa, perianthii tubo perbrevi, lobis 4, ellipticis ciliatis extus pubescentibus intus glabris; flores ♂ staminibus 6, filamentis pubescentibus. Flores ♀ parvi, staminodiis circiter 6, ovario ovoideo glabro, stigmate discoideo. Fructus ellipsoideus, 15–17 mm. longus, 10–12 mm. latus, brunneus, glaber, disco parvo plano, pedicello percrasso 8 mm. longo 2 mm. lato.

Distribution: China (Hainan).
China. hainan: *N. K. Chun & C. L. Tso 44131* (type, AA); *F. C. How 73420; H. Y. Liang 63482; N. K. Chun & C. L. Tso 44163; C. Wang 34652, 35857.*

A very unusual species as to petioles and branchlets which are rugose and yellowish brown. In fruit, the pedicels are much more thickened than normally is the case in *Neolitsea*, and are elongated. The appearance of the fruiting branch as a result is clumsy.

23. **Neolitsea polycarpa** Liou, Laurac. Chine Indoch. 150. 1932.

DISTRIBUTION: French Indo-China.

FRENCH INDO-CHINA. TONKIN: *E. Poilane 13093.*—ANNAM: *E. Poilane 11025.*

The species is characterized by elliptic, very long-acuminate, rather coriaceous leaves 11 × 3.5 cm., glaucous below. The branches are subverticillate, an unusual feature to be noted on an herbarium sheet. The species is similar to *N. zeylanica* (Nees) Merr. but is distinguished from the latter by the above characters. Only the fruiting inflorescence and young female flowers have been described. Liou places the plant in *Neolitsea* because of the floral structure. Staminate material may change this conception.

24. **Neolitsea Chuii** Merr. Lingnan Sci. Jour. 7: 306. 1929; Liou, Laurac. Chine Indoch. 147. 1932.

Neolitsea subfoveolata Merr. Lingnan Sci. Jour. 7: 306. 1929, in nota; Merr. apud Groff, Lingnan Univ. Sci. Bull. No. 2: 48. 1930, *nomen nudum;* Metc. Lingnan Sci. Jour. 14: 525. 1935.

DISTRIBUTION: China.

CHINA. KWANGTUNG: *W. T. Tsang & F. Wong 14799* (type of *Neolitsea Chuii*, NY); *W. T. Tsang 20193; F. A. McClure 13756* (type of *N. subfoveolata* not seen, NY?); *W. Y. Chun 5744; S. P. Ko 50087, 50091, 50249; T. M. Tsui 769; S. S. Sin 11880.*—KIANGSI: *S. K. Lau 4696.*—KWANGSI: *R. C. Ching 8229.*

The species is characterized by its coarse triplinerved, elliptic to oblong-elliptic to ovate-elliptic leaves, minutely reticulate on both surfaces. The plant is glabrous throughout except for the inflorescence. No staminate specimen as yet has been reported but it is undoubtedly a *Neolitsea*. The specimen collected by Chun has been misdetermined several times, hence it is included above. Metcalf has seen the types or isotypes of *Neolitsea Chuii*, and *N. phanerophlebia* (from which Merrill,

l.c. distinguishes *N. subfoveolata)* as well as *McClure no. 13756* cited by Groff as *N. subfoveolata* Merr. Thus his interpretation is without doubt correct, and should be accepted. The specimens collected by Tsai *(51693, 51551, 51676, 51718)*, and determined by Hu as *N. Chuii*, perhaps should be treated as a western variety of that species, since there are apparent differences between these and the plants from Kwangtung. For the present it is best that they remain under the species.

24a. **Neolitsea Chuii** Merr. f. **annamensis** Liou, Laurac. Chine Indoch. 147. 1932.

DISTRIBUTION: known only from type locality.
FRENCH INDO-CHINA. ANNAM: *E. Poilane 1142* (type, Paris).

The leaves of this form are smaller, have shorter petioles and more apparent transverse veins.

25. **Neolitsea phanerophlebia** Merr. Lingnan Sci. Jour. 7: 305. 1929; Liou, Laurac. Chine Indoch. 149. 1932.

DISTRIBUTION: China (Kwangtung).
CHINA. KWANGTUNG: *K. P. To, W. T. Tsang & U. K. Tsang 12515* (type, NY); *T. M. Tsui 740, 822; W. T. Tsang 21230.*

The species suggests *N. Chuii* Merr., but it differs in the presence of an indumentum on the leaves, branchlets and petioles, the leaves being more glaucous beneath and distinctly appressed-pilose with scattered hairs. Merrill gives the lack of subfoveolate leaves as another distinction, but I can see no difference in the reticulation of the two species.

25a. **Neolitsea phanerophlebia** Merr. f. **glabra** Liou, Laurac. Chine Indoch. 149. 1932.

DISTRIBUTION: China (Kwangtung and Kiangsi).
CHINA. KWANGTUNG: *C. Wang 3221* (type, NY); *N. K. Chun & C. L. Tso 44294.*—KIANGSI: *S. K. Lau 3981, 4423, 4820.*

This is a very striking plant, first because of its small leaves glaucous beneath, and second because the two basal lateral veins are so prominent as to appear triplinerved. They branch off from the midrib 1–2 mm. above the base and follow the outline of the leaf, about 1–2 mm. from the margin, up to the middle of the leaf. Numerous specimens have been labeled as

the variety *glabra,* but they are the new species *N. Merrilliana* Allen.

EXCLUDED SPECIES

Neolitsea Playfairii (Hemsl.) Chun, Contr. Biol. Lab. Sci. Soc. China, 1[2]: 66. 1925 = **Lindera Playfairii** (Hemsl.) comb. nov., see p. 400.

Neolitsea subcaudata Merr. Philip. Jour. Sci. Bot. **13**: 137. 1918 = **Lindera subcaudata** (Merr.) Merr.

Neolitsea spec. Rehd. Jour. Arnold Arb. **10**: 193. 1929 = **Litsea Kobuskiana** Allen, nom. nov.

Neolitsea spec. Rehd. l.c. = **Litsea Dunniana** Lévl.

INDEX

Synonyms are printed in *italics;* new names in **bold-face** type.

A MONOGRAPH OF THE GENUS HEMIMERIS

ADELE LEWIS GRANT

Lecturer in Botany, University of Southern California, Los Angeles

HISTORY

The genus *Hemimeris* was first described by Linnaeus[1] in 1760. He neglected to explain the origin of the name, but according to Sir J. J. Smith[2] it is derived from two Greek words, ἡμί, meaning "half" and μέρος, "a part or fragment," referring to the flower which is cut away on one side, that is, lacking a spur. It has been claimed that it was because of this character that Linnaeus originally separated this group from *Antirrhinum.* The name might possibly refer as well to the stamens, inasmuch as *Hemimeris* has half the number found in most genera of the *Scrophulariaceae.*

The status of the name has become confused since it has not been possible to determine exactly what Linnaeus had in mind when he described *Hemimeris bonae-spei,* and also by the fact that Linnaeus fil., in dealing with *Hemimeris,* entirely ignored his father's description and formulated a new one based chiefly upon plants collected by Thunberg. The name *Hemimeris bonae-spei,* some authorities claim, was applied by Linnaeus to the plants now known as *Diascia diffusa.* Were this true, the name *Diascia* would have to be included in the list of *Nomina Conservanda,* or the plants known by that name for one hundred years or more would have to be changed to *Hemimeris* and those now known as *Hemimeris* would have to be given another name. Hiern believed that this change should be made,[3] and in the original manuscript for the 'Flora Capensis' actually did interchange the two names. However, Thiselton-

[1] L. Pl. Rar. Afr. 8. 1760.

[2] J. J. Smith in Rees' Cycl. 17: 44. 1819.

[3] Hiern in Jour. Bot. 39: 103. 1901.

Issued December 27, 1937.

Dyer, the editor, did not agree and published[4] the account under the names in use at that time. The present writer does not accept the argument set forth by Hiern and agrees with Bentham[5] that the name *Hemimeris* should be maintained for the group under discussion.

The history of the genus is somewhat complicated. Linnaeus described *Hemimeris bonae-spei*[6] in 1760, as follows: "Veronica africana, floribus ad genicula pedicellis biuncialibus. Herm. Afr. 783, (Pluk. phyt. 320. *f.5*). Herba statura pedicularis. Caules pedales, prostrati, laeves. Folio inferne terna (superiora ad flores saepe alterna), petiolata, lanceolata, obtusa, pinnatifida. Flores axillares, alternii. Pedunculo longo, sed calyx 5-partitus." The illustration cited from Plukenet is *Scoparia dulcis* according to Britten.[7]

Linnaeus later transferred *Hemimeris bonae-spei* to *Paederota* as *P. bonae-spei*[8] and repeated the original description, adding the phrase "fol. pinnatifidis" and placing the whole under "Diandra." Hiern stated that this last addition "made no difference in effect,"[9] but it is difficult to understand why he took this position in view of the fact that the most important difference between the two genera is that there are two stamens in *Hemimeris* and four in *Diascia*. It must be recalled also that the true *Paederota* has two stamens. The rest of the description is a repetition of the original and most of it could fit any one of the species now known as *Hemimeris sabulosa, H. montana, Diascia diffusa,* or *D. Bergiana,* with the exception of the color "purpurei lineis albentibus." This is the color of the flowers in *Diascia diffusa* and *D. Bergiana. Hemimeris* has yellow flowers. The phrase "folia inferne terna" does not apply to any species of *Diascia* now known, but in several specimens of *Hemimeris sabulosa* the lower leaves appear to be ternate and in some collections the lowermost are trilobed. The

[4] Th.-Dyer in Fl. Cap. 4[2]: 139. 1904.
[5] Benth. in Hook. Comp. Bot. Mag. 2: 13. 1836.
[6] Linn. l.c.
[7] Britten in Jour. Bot. 47: 45. 1909.
[8] Linn. Sp. Pl. ed. 2, 20. 1762; Amoen. Acad. ed. 1, 6: 83. 1763, and ed. 2, 1764.
[9] Hiern, l.c.

use of the name *Paederota bonae-spei* was continued through many subsequent publications and always under "Diandra."

In the synonymy given in the 'Amoenitates Academicae,' Linnaeus refers to a plant in "Pet. mus. 245," [recte 345]. This is in the Herb. Sloane in the British Museum, vol. 156, *f. 157,* and is *Hemimeris montana* without question. This is also the plant referred to in Roy. Lugd. 416. 1740, as "Anagallis foliis sinuatis." Linnaeus, in his original paper, stated that the plants described were based upon material mostly in the Burmann collection. This was a miscellaneous collection of specimens of Cape plants gathered by Hermann, Oldenland, Auge, and others. In the Burmann herbarium at Geneva, there are seven sheets of plants belonging to *Hemimeris,* four of which are *H. sabulosa* and three *H. montana.* There are six sheets of *Diascia,* four being *D. diffusa,* the common species in the vicinity of the Cape, one *D. macrophylla,* and one which may be identified with some doubt as *D. Bergiana.* The collectors of these plants are unknown.

In the Linnaean Herbarium at London there are three sheets of *Hemimeris montana,* one of *H. sabulosa,* and two of *Diascia diffusa.* These were collected by Sparrman, Thunberg, or Fabricius, after Linnaeus had published his 'Plantae Africanae Rariores,' so may be disregarded as far as this problem is concerned. That confusion existed in the mind of Linnaeus at this time is evidenced by the labels on the three sheets of *Hemimeris montana,* two being labelled by him as "montana" and the third as "diffusa."

Linnaeus fil. described the genus *Hemimeris*[10] without any reference whatever to a previous publication. He listed *H. sabulosa, H. montana,* and *H. diffusa,* citing Thunberg's collections and placing all of them under "Didynamia" in spite of the fact that his *H. diffusa* was the only one having four stamens. Both Lamarck[11] and Richter[12] claim that Linnaeus fil. considered *H. diffusa* to be a variety of *H. sabulosa.* Thunberg,[13] Jussieu,[14] and Willdenow[15] also listed the species with

[10] Linn. f. Suppl. 45 and 280. 1781.
[11] Lamarck, Cycl. 3: 104. 1789.
[12] Richter, Codex. 29. 1840.
[13] Thunberg, Nov. Gen. Pl. 74. 1784.
[14] Jussieu, Gen. Pl. 120. 1789.
[15] Willdenow, Sp. Pl. 3: 282. 1800.

either two or four stamens under *Hemimeris,* and in Richter's 'Codex,' we find *Paederota bonae-spei* used for the last time.

Sir J. J. Smith[16] in Rees' 'Cyclopaedia' gave *Paederota bonae-spei* as a synonym of *H. diffusa* saying, "We can hardly doubt that the original *Hemimeris* (afterward called *Paederota) bonae-spei* is this species though it was at first described as diandrous." This opinion is discredited by the fact that there is in the Linnaean Herbarium a sheet of so-called *Hemimeris diffusa* on which the "*Hemimeris*" is in Linnaeus' handwriting, the "*diffusa*" in that of his son, and on the back of the same sheet, again in Linnaeus' handwriting, is a description of the plant which Smith claims is the original description. For some reason, Smith failed to note that this plant was collected by Sparrmann some years after *Hemimeris* was first published and therefore it cannot be the original description.

Link and Otto[17] described the genus *Diascia* in 1820, basing it upon material grown from seed sent by Bergius from the Cape. They named the species *D. Bergiana* and in no way did they refer to any previous publication nor suggest possible relationship between *Diascia* and any other genus. Sprengel[18] recognized *Diascia* as a genus under the caption "Didynamia" and listed four species, three of which belong in *Diascia,* as now interpreted, and one in *Hemimeris.* Under the latter genus, he enumerated a number of species, all natives of South America, which are now attributed to *Alonsoa.*

Bentham,[19] in his synopsis of the *Hemimeridae,* was the first to separate the two groups definitely, retaining the name *Hemimeris* for the plants having two stamens and *Diascia* for those with four. He did this, he said, because the name *Diascia* was more particularily applicable to the form of the corolla of that group. However, he followed Smith in believing that Linnaeus referred to a four-stamened flower in the original description. As a matter of fact, no reference was made to the number of stamens in the first publication. Bentham listed

[16] J. J. Smith in Rees' Cycl. 17: 44. 1819.
[17] Link & Otto, Ic. Pl. Sel. 7, *t.2.* 1820.
[18] Sprengel, Syst. Veg. ed. 16, 2: 800. 1825.
[19] Benth. in Hook. Comp. Bot. Mag. 2: 13. 1836.

three species under *Hemimeris* and seventeen under *Diascia.* Hiern, the most recent author to study these genera in detail, as mentioned before, believed that the generic names should be transposed. He based most of his argument upon plants in the Sloane collection, none of which were collected by Hermann, and upon certain plants in the Linnaean herbarium which, as shown above, were collected after Linnaeus had described the genus. Four species were listed under the generic name *Hemimeris* in the 'Flora Capensis.'

GEOGRAPHICAL DISTRIBUTION

Hemimeris is a small genus confined to the western and southwestern parts of the Cape Province in South Africa. It grows commonly in soil of decomposed sandstone, in crevices where there is more or less moisture, and in cultivated areas of clay or sandy loam. Its center of distribution is in the Cape and in the adjacent districts of Stellenbosch, Paarl, and Malmsbury, where it sometimes becomes so abundant as to color a large area. The two common species, *H. sabulosa* and *H. montana,* occur chiefly in this region. Both continue northward into Namaqualand, *H. montana* occurring almost as far north as the Orange River, and eastward along the coast for some distance. *H. centrodes* is a somewhat localized northwestern species, having been collected only in the Bokkeveld and in the mountains of the Calvinia District. *H. gracilis* seems to be even more restricted, but that may be due to a paucity of collections from the areas in which it grows. It is represented by only a few sheets of specimens gathered in the Worcester District, in the Onder Bokkeveld, and near Van Rhynsdorp. In the Onder Bokkeveld, it occurs within the range of *H. centrodes.*

PHYLOGENY

H. sabulosa appears to be the most primitive species of *Hemimeris* in having the least specialized corolla and more or less glabrous stems. The corolla is more nearly regular and the pouches are not at all well developed. One can readily conceive that *H. montana* has been derived from some such primi-

tive type through specialization toward a more conspicuously irregular corolla and larger pouches. The sacs of *H. montana* are prominent and the stamens frequently are hidden by the overarched posterior corolla lip. The size of the sacs varies considerably, and specimens in which they have attained almost the length of the lateral lobes have been designated as var. *pachyceras*. This variety is found mostly in the semi-arid parts of the western Cape Province, extending north into Namaqualand and east as far as Calvinia.

Through enlargement and elongation of the spurs, it is not difficult to hypothesize the remaining two species as having been derived from *H. montana*. *H. centrodes* and *H. gracilis* are localized species in which long spurs have been developed. *H. centrodes* superficially resembles *Diascia,* especially *D. macrophylla,* and has therefore been confused with members of that genus. *H. gracilis* differs from its congeners in having a conspicuously winged style and strongly divergent spurs. Certain other species have narrowly winged styles but in *H. gracilis* this tendency attains an extreme development.

In its affinities, *Hemimeris* unquestionably approaches *Diascia* closely. It differs from *Diascia* chiefly in the reduction of the number of stamens and in the method of the dehiscence of the capsule, this occurring in such a way that the base of the persistent style is split into four parts. In *Diascia* the base of the style is split into two parts, as a rule, but sometimes into four. The two genera are alike in the basal circumflexion of the anterior stamens, in having two sacs or spurs, and in the general shape of the capsule. In both genera the seeds are usually destitute of wings, but occasionally narrow wings are developed.

ABBREVIATIONS

Abbreviations indicating the herbaria in which specimens cited in this paper are deposited are as follows:

A—Albany Museum at Grahamstown.

B—Herbarium of the Botanic Garden and Museum in Berlin-Dahlem.

BH—Bolus Herbarium at the University of Cape Town.

BM—Herbarium of the British Museum (Natural History), London.

F—Herbarium of the Field Museum of Natural History, Chicago.

FH—Herbarium of Mr. H. G. Fourcade.

G—Gray Herbarium of Harvard University, Cambridge.

Gen—Herbarium of the Botanic Garden, Geneva.

K—Herbarium of the Royal Botanic Gardens, Kew.

L—Linnaean Herbarium of the Linnaean Society, London.

M—Herbarium of the late Dr. Marloth, now a part of the National Herbarium in Pretoria.

MBG—Herbarium of the Missouri Botancial Garden, St. Louis.

P—Herbarium of the Academy of Natural Sciences of Philadelphia.

US—United States National Herbarium, Washington.

The author wishes to express her sincere appreciation to the curators of the herbaria enumerated above for their courtesy and aid during her study of *Hemimeris,* especially to Sir Arthur W. Hill and Mr. A. D. Cotton, of the Royal Botanic Gardens at Kew, and Dr. Louisa Bolus, of the Bolus Herbarium, University of Cape Town.

TAXONOMY

Hemimeris L. Pl. Rar. Afr. 8. 1760, in part; L. f. Suppl. 45. 1781, in part; Murray, Syst. Veg. 561. 1784, in part; Thunb. Nov. Gen. Pl. 74. 1784, in part; Prodr. 105. 1800, in part; Fl. Cap. [ed. Schult.] 484. 1823, in part; Juss. Gen. Pl. 120. 1789, in part; ed. 2, 134. 1791, in part; Lam. Cycl. **3**: 104. 1789, in part, and Suppl. **3**: 45. 1813; L. Gen. Pl. ed. 8 [by Schreber] **2**: 409. 1791, in part; Willd. Sp. Pl. **3**: 282. 1800, in part; Gaertn. f. Fruct. et. Sem **3**: 21, *t. 183.* 1807; J. J. Smith in Rees' Cycl. **17**: 4H. 1819, in part; Spreng. Syst. Veg. **2**: 809. 1825; Endl. Gen. Pl. 672. 1836–40, in part; Benth. in Hook. Comp. Bot. Mag. **2**: 15. 1836; DC. Prodr. **10**: 255. 1846; Harv. Gen. S. Afr. Pl. 255. 1838; Benth. & Hook. Gen. Pl. **2**: 931. 1876; Hiern in Th.-Dyer, Fl. Cap. **4**^{2}: 164. 1904; Thonner, Fl. Pl. Afr. 490.

1915; Bews, Fl. Natal. 182. 1921; Phillips, Gen. S. Afr. Pl. 544. 1926; Levyns, Fl. Cape Pen. 224. 1929; Marloth, Fl. S. Afr. 3^1: 129. 1932.

Paederota L. Sp. Pl. ed. 2, 20. 1762, in part; Amoen. Acad. ed. 1, **6**: 83. 1763, in part; and ed. 2. 1764, in part; Houtt. Handl. ed. 2, **7**: 107. 1777, in part; Richter, Codex, 29. 1840, in part.

Annuals, glabrous, glandular-pubescent or viscid-villous. Stems simple or more or less freely branched, quadrangular, often channelled or ridged; branches opposite. Leaves opposite, the uppermost sometimes alternate, petiolate, rarely sessile, simple, toothed, lobed, or pinnatifid, rarely almost entire, often with smaller leaves fascicled in the axils; cotyledonary leaves smaller, frequently persistent, petiolate, ovate, usually entire. Flowers axillary or terminal, solitary or more often in condensed racemes at the apex of the stem, these frequently with such short internodes as to appear umbellate; pedicels longer than the flowers, erect at anthesis, spreading or deflexed in fruit. Calyx campanulate, scarcely imbricate, 5-lobed, the lobes free nearly to the base, unequal. Corolla bilabiate, generally villous externally, yellow; tube very short or obsolete; throat short; the upper lip emarginate, smaller, exterior in the bud, usually with a reflexed margin and a more or less well-developed pouch near the center; lower lip 3-lobed, the lateral lobes short and broad, commonly with a large number of compound subsessile glands toward the base and two pouches or spurs at the base of the lip, the basal part of which is covered with sessile glands, sometimes with two appendages at the sides of the throat, lowermost lobe concave, much longer and broader, usually emarginate. Stamens 2, erect, inserted on the sides of the narrow throat; filaments usually compressed and often narrowly winged, circumflexed at the base; anthers large, one-celled through confluence, usually connivent when mature; pollen grains oval or rounded, smooth, pores numerous. Ovary 2-celled with axile placentation; style persistent, usually declined, longer or shorter than the ovary, frequently winged, the terminal portion stigmatose. Capsule ovate or subglobose, dehiscent both septicidally and loculicidally in

varying degrees, generally splitting the base of the style into four parts; placentae coherent, forming a central column. Seeds numerous, brown or black, oval, scarcely 1 mm. long, papillate, occasionally very narrowly winged. Embryo straight; cotyledons entire.

The position of the stamens and style in relation to one another and the well-developed nectaries at the base of the spurs or sacs would indicate that the flowers are insect-pollinated.

Standard species: *H. sabulosa* L. f. Suppl. 280. 1781. In view of the confusion existing as to the exact identity of *H. bonae-spei* and the apparent impossibility of settling it absolutely, *H. sabulosa* is designated as the standard species of the genus.

KEY TO THE SPECIES

A. Corolla with sacs or spurs much shorter than the lower lip of the corolla.
a. Plants glabrous or nearly so; leaves lobed or pinnatifid; pouches shallow .... *1. H. sabulosa*
aa. Plants pubescent to villous; leaves shallowly or deeply toothed, rarely entire; pouches well developed.......................... *2. H. montana*
AA. Corolla with spurs as long as or longer than the lower lip of the corolla.
b. Corolla 0.8–1.5 cm. long, spurs nearly parallel, often incurved; style not conspicuouly winged.................................. *3. H. centrodes*
bb. Corolla 0.4–0.6 cm. long, spurs straight, strongly divergent; style conspicuously winged.. *4. H. gracilis*

1. **H. sabulosa** L. f. Suppl. 280. 1781; Thunb. Nov. Gen. Pl. 79. 1784; Prodr. 105. 1800; Fl. Cap. [ed. Schult.] 485. 1823; Murray, Syst. Veg. ed. 14, 561. 1784, and ed. 15, 598. 1797; Lam. Cycl. **3**: 104. 1789; Ill. *t. 532, fig. 2.* 1823; Willd. Sp. Pl. **3**: 282. 1800; Martyn in Mill. Dict. ed. 9. **1**: 142. 1807; Smith in Rees' Cycl. **17**: 4H. 1819; Benth. in Hook. Comp. Bot. Mag. **2**: 16. 1836; DC. Prodr. **10**: 256. 1846; Hiern in Th.-Dyer, Fl. Cap. **4²**: 166. 1904.

Paederota bonae-spei L. Sp. Pl. ed. 2, 20. 1762, in part; Amoen. Acad. ed. 1, **6**: 84. 1763, in part, and ed. 2. 1764, in part, not Burm. f.; Hout. Handl. ed. 2, **7**: 107. 1777, in part; Murray, Syst. Veg. 61. 1797, in part; Richter, Codex, 29. 1840, in part.

[*Veronica Africana floribus ad genicula pediculis biuncialibus insidentibus.* Burm. Cat. Pl. Afr. 23. 1737.]

[*Alsines seu Spergulae dictae species africana.* Burm. Cat. Pl. Afr. 23. 1737.]

Annuals; stems quadrangular, simple or branched, erect or prostrate, glabrous or nearly so, 5–50 cm. high, frequently tinged with red; leaves opposite, thin, 1–4 cm. long, 0.2–1.0 cm. wide, ovate or oblong, sometimes nearly linear, obtuse, conspicuously dentate with blunt teeth to pinnatifid, occasionally 3–5-lobed, dark green or reddish, petioles usually slender, shorter than the blade, often with smaller leaves fascicled in the axils; flowers in the axils of the upper leaves, these frequently with such shortened internodes as to give an umbellate appearance, or terminal on short branches; pedicels accrescent, 1.5–3.0 cm. long, spreading or deflexed at maturity; calyx-lobes 1.5–2.5 mm. long, oblong or lanceolate, obtuse or acute, unequal, the three upper erect and smaller, the two lower spreading; corolla yellow with white hairs without, glabrous within, 1.0–1.5 cm. long, upper lobes erect, emarginate, 3–4 mm. long, with a more or less circular depression below the center and generally with two patches of brown spots on either side of this, lateral lobes about 3 mm. long and 2 mm. wide, with groups of sessile glands near the center and an elongated shallow sac toward the base, lower lobe broadly rounded or oblong,

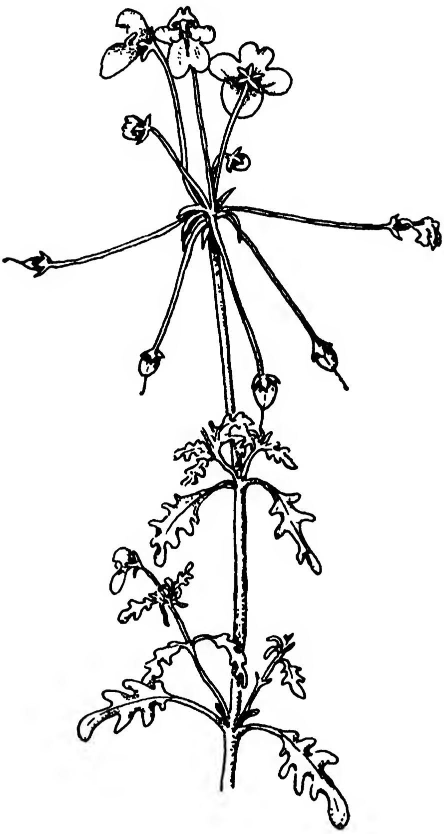


Fig. 1. *Hemimeris sabulosa* L. f., plant × 1.

6–8 mm. long and about as wide, throat very short; stamens erect, filaments glabrous, more or less winged, anthers coherent, not hidden by the upper lip; style longer than the stamens, bent toward the lower lip; capsule glabrous, globose or ovate, 4–5 mm. long, much longer than the calyx; seeds oval, brown, papillate.

Distribution: common in sandy soil from the Cape to Namaqualand and east to Riversdale, flowering from July to November.

CAPE PROVINCE: without definite locality or date, *Forbes* (K, B); *Harvey* (K); *Menzies* (K); *Thunberg 185* (L, TYPE); ex Link Herb. (B); *Mund & Maire* (B); *Burmann* (Gen); *Sieber 381* (Gen, MBG); Doorn River, Sept., 1900, *Pritzel* (B); Alexander's Hoek, 2 Sept., 1894, *Schlechter 5137* (A, B); Zeekoe Vlei, 12 Aug., 1896, *Schlechter 8482* (K, B, Gen, A, US, P, MBG); Olifant's River and near Brakfontein, 1836, *Zeyher 1268* (K, B); Clanwilliam, Aug., year lacking, *Ecklon & Zeyher* (A); Clanwilliam, *Zeyher* (K); Veld Drift, 29 Sept. 1927, *Grant 3461* (Gen, K, P, MBG); near Hopefield, Sept., 1885, *Bachmann 1168* (B); same locality, Aug., 1886, *Bachmann 1167* (B); Sept., 1883, *Bachmann 75, 1169* (B); near Hopefield, 11 Aug., 1929, *Grant 4639* (K, Gen); sandy areas between Darling and Yserfontein, 18 Aug., 1929, *Grant & Theiler 4652* (K, B, Gen, BH, P, MBG); Zwaartwater Farm, near Darling, 30 Sept., 1926, *Grant 2525* (BH, K, P, MBG); Yserfontein, 30 Sept., 1926, *Grant 2582* (BH, B, P, MBG); along roadside between Darling and Yserfontein, 30 Sept., 1926, *Grant 2551a* (BH, K, P, MBG); Paarl, date lacking, *Drege* (A); Hottentot's Holland, date lacking, *Sprengel's Herb. 381* (B); near Zoutrivier, 15 Sept., 1816, *Bergius* (B); strand by Green Point, 19 Sept., 1883, *Wilms 3499* (B); Kalk Bay, Oct., year lacking, *Pappe* (A); Simon's Bay, 1853–56, *Wright* (G, US); Cape, 21 Aug., 1816, *Bergius* (B); sand flats between Blaauberg and Tygerberg, date lacking, *Drege 3151d* (K, MBG); mountains near Cape Town, date lacking, *Ecklon* (K, B); sand dunes, Cape Town, date lacking, *Prior* (K, G); Camp Ground near Cape Town, 15 Aug., 1895, *Wolley Dod 163* (K); Zeekoe Vlei near Cape Town, 28 Sept., 1929, *Starke* (MBG, P); near Muizenberg, 31 July, 1892, *Schlechter 1266* (K, B, A, Gen); Elands Kop in the Duinen, Riversdale District, Sept., 1914, *Muir 1764* (A).

Undoubtedly Linnaeus had this species in mind when he described *Hemimeris bonae-spei*, as stated before. However, since he confused several things in his original description and since the specimen of Hermann upon which he based the genus cannot be found, it seems advisable to retain the well-established name *Hemimeris sabulosa* and so avoid possible confusion.

The specimen of Bergius collected in 1816 from "Cape Bonae Spei" differs from most of the other collections in having

leaves intermediate between *H. sabulosa* and *H. montana.* The glabrous character of the plant and the flowers are like those in typical specimens of *H. sabulosa. Schlechter 1266,* as seen in several herbaria, has similar leaves, some of which are trilobed. The specimens of Pappe at the Albany Museum resemble those collected by Schlechter.

2. **H. montana** L. f. Suppl. 280. 1781; Thunb. Nov. Gen. Pl. 75. 1784; Prodr. 105 1800; Fl. Cap. [ed. Schult.] 484. 1823; Murray, Syst. Veg. 561. 1784; Willd. Sp. Pl. **3**: 282. 1800; Martyn in Miller, Dict. ed. 9, **1**: 142. 1807; Smith in Rees' Cycl. **17**: 4H. 1819; Benth. in Hook. Comp. Bot. Mag. **2**: 16. 1836; DC. Prodr. **10**: 255. 1846; Hiern in Th.-Dyer, Fl. Cap. **4**^{2}: 165. 1904; Levyns, Fl. Cape Pen. 224, *fig. 167.* 1929.

Hemimeris alsinoides Lam. Cycl. **3**: 105. 1789; Ill. *t. 532. fig. 1a–b.* 1823.

Hemimeris sinuata Smith in Rees' Cycl. **17**: 4H. 1819.

Hemimeris sessilifolia Benth. in Hook. Comp. Bot. Mag. **2**: 16. 1836, excluding Burchell's specimen; DC. Prodr. **10**: 255. 1846.

Diascia montana (L. f.) Spreng. Syst. Veg. **2**: 800. 1825.

Hemimeris montana L. f. var. β *latipes* Benth. in DC. Prodr. **10**: 256. 1846.

Hemimeris latipes Backhouse ex Hiern, in Th.-Dyer, Fl. Cap. **4**^{2}: 165. 1904.

Diascia Scullyi Hiern in Th.-Dyer, Fl. Cap. **4**^{2}: 144. 1904.

? *Paederota racemosa* Houtt. Handl. ed. 2, **7**: 110, *t. 38, fig. 1.* 1777.

[*Anagallis purpurea bursa pastoris foliis minoribus* Petiv. Mus. 36. no. 345. 1695; Roy. Ludg. 416. 1740.]

[*Anagallis capensis Chamaedryos folio, caule piloso* Ray, Hist. Pl. **3**, app. 241. 1704.]

[*Alsine chamaedrios foliis bijugis Spergula floribus* Pluk. Phyt. *t. 331, fig. 3.* 1691; Mant. 9, *t. 331, fig. 3.* 1700.]

Stems 8–35 cm. long, quadrangular, often channelled, simple, or more commonly branched, erect or ascending, occasionally weak and more or less scrambling, usually glandular and viscid-villous with conspicuous white hairs, sometimes nearly

glabrous; leaves broadly or narrowly ovate, occasionally lanceolate or elliptical, obtuse or less often acute, commonly serrate with blunt teeth, at times nearly entire, 1–5 cm. long, 0.5–2.5 cm. wide, generally much shorter than the internodes, dark green above, sometimes tinged with red or reddish-purple, pubescent or villous, frequently with a group of long white hairs near the base, petioles slender, more or less winged, shorter or nearly as long as the blade, rarely longer, uppermost leaves with shorter petioles, occasionally subsessile; flowers mostly in terminal umbellate clusters consisting of 4–12 or more flowers subtended by leaf-like bracts, or sometimes axillary or solitary on short slender branches; pedicels generally filiform and more or less ribbed, infrequently flattened and more or less winged, 1–5 cm. long, glabrous to densely glandular-pubescent, ascending or nearly erect, sometimes deflexed when mature; buds conspicuous because of the white viscid-villous hairs on the outside of the corolla; calyx-lobes unequal, the uppermost one obovate, obtuse, the others narrower, elliptical or oblong, acute or obtuse, 1.5–2.5 mm. long, white viscid-villous to nearly glabrous; corolla bilabiate, yellow, viscid-villous without, upper lip strongly arched, 2–5 mm. long, emarginate, often with a somewhat circular group of brown spots on either side, lateral lobes larger, rounded, almost as long as broad, spreading, glandular-punctate toward the base and each with a rounded or oval sac at or below the center, this about 1 mm. long and about as deep, sometimes partly closed by two ascend-

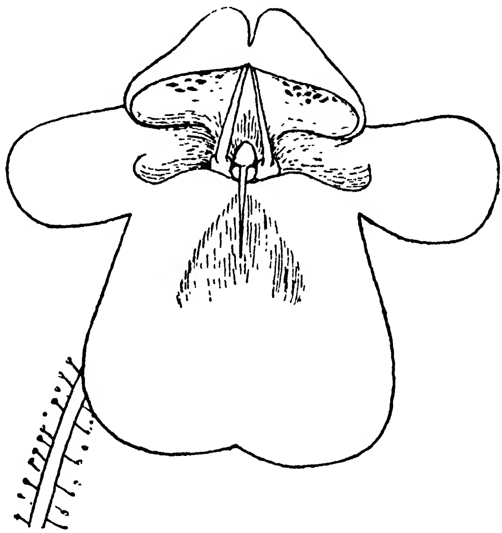


Fig. 2. *Hemimeris montana* L. f., flower × 6.

ing appendages, lowermost lobe broadly oblong, concave, 4–8 mm. long, 3–7 mm. broad, glandular-punctate near the base, truncate or rounded, usually emarginate; stamens included, anthers generally hidden within the arched upper lip, filaments glandular-pubescent, erect, anthers large, connivent; style longer than the stamens, inclined toward the lower lip, apex stigmatose; capsule glabrous or puberulent, broadly ovate or subglobose, as long as or slightly longer than the calyx, dehiscent nearly to the base along the outer suture and frequently part way from the top along the inner suture, splitting the style base into 4 strands; seeds oval, minute.

Distribution: abundant in sandy areas from the Cape to Namaqualand and east along the coastal region to Port Elizabeth District. Growing under bushes, in the open veld, in cultivated land or in the shade of rocks, frequently where it is moist. Flowering from July to November.

CAPE PROVINCE: without definite locality or date, *Garcin* in Burmann Herb. (Gen); *Thunberg*, in Linnaean Herb. (L TYPE); *Sparrmann 6* in Linnaean Herb. (L); *Oldenland* in Herb. Sloane (BM); *Prior* (K); Jan. 1880, *Rogers 13* (K); *Reeves* (K); *Harvey* (K); *Pappe* (K); *Sieber 144* (K, B, Gen); *Forbes* (K); *Burmann Herb.* (Gen); *Zeyher* (B, A); *Bergius* (B); *Mund & Maire* (B); *Ascherson* (B); Khamiesberg, under rocks, Beaem Hill, 15 Sept., 1911, *Pearson 6685* (K); Khamiesberg, Aug.–Sept., year lacking, *Bolus 9436* (BH, P, MBG); Namaroup, Sept., 1911, *Pearson 6600* (K); under rocks, Kharkams, Sept., 1911, *Pearson 6715* (K); Giftberg, Sept., 1911, *Phillips 7353* (K); Steinkop, Aug., 1925, *Marloth 6770* (M); Klipfontein, 8 Sept., 1925, *Marloth 12676* (M); Namaqualand Minor, Aug.–Sept., 1883, *Bolus 9436* (BH, P, MBG); Calvinia, 18 Sept., 1900, *Diels 759* (B); Nieuwerfontein, 26 Sept., 1929, *Grant 4869a* (BH, K, NH, P, MBG); Van Rhyns Pass, 28 Sept., 1929, *Grant 4880* (BH, P, MBG); Klaver, 30 July, 1920, *Andreae 428* (M); Klaver, 13 Sept., 1926, *Marloth 12942* (M); Cedarbergen, near Wupperthal, date lacking, *Drege 3151b* (K); Wupperthal, date lacking, *Drege 3151* (K); Het Kruis, Sept., 1912, *Stephens & Glover 8789* (K); Saldanha Bay, 7 Sept., 1929, *Grant 4546* (K, B, BH, P, MBG); Saldanha Bay, Sept., 1827, *Verreaux* (Gen); between Darling and Yserfontein, 18 Aug., 1929, *Grant 4658* (BH, P, MBG); Darling, Aug., 1883, *Bachmann 545* (B); Paarde Berg and Zwartland, date lacking, *Ecklon* (K, TYPE of *H. sessilifolia* Benth.); Wellington, Aug., 1886, *Cummings 74* (P, US); Stellenbosch, 1865, *Sanderson 972* (K); at the foot of Paarl Mt., date lacking, *Drege* (K, MBG); Diep Rivier, Oct., 1827, *Verreaux* (Gen); Simonstown, Aug., 1912, *Rogers 11247* (A); Simons Bay, 1853–56, *Wright* (K, US, MBG); above Groot Schuur, 29 July, 1895, *Wolley Dod 165* (K); Table Mt., Aug., year lacking, *Ecklon 391* (K, MBG); Camp Ground near Cape Town, Aug., 1875, *Bolus 2872* (K); Lion's Head near Camps Bay, Oct., 1896, *MacOwan 1768* (K, B, Gen); near Cape Town, date lacking, *Harvey 414* (K);

Cape of Good Hope, year lacking, *Harvey* (K, TYPE of *H. montana β latipes* Benth.); in grassy fields and shady places near the Cape, Aug.–Sept., year lacking, *Pappe* (K); waterfall on Devil's Peak, July, 1883, *Wilms 3497* (B, Gen, P); Cape of Good Hope, 1831, *Verreaux* (Gen); Cape of Good Hope, date lacking *Ecklon & Zeyher* (Gen); throughout Cape District, Aug., 1838, *Krauss 1634* (MBG); Cape, *Drege* (Gen); Table Mt., near Camps Bay, Aug., 1900, *Diels 17* (B); Camps Bay, Sept., 1884, *Marloth 461* (M); near Cape Town, Sept., year lacking, *Lehmann* (G); sand dunes near Cape Town, 5 Aug., 1846, *Prior* (K); Roggeveld Mts., 6 Aug., 1811, *Burchell 1307* (K); in sandy places, Tulbagh Kloof, Sept., 1888, *Tyson 2296* (M); Nieuwkloof near Tulbagh, Oct., 1886, *MacOwan 821*, in part (K, Gen); Hex River Pass, 13 Oct., 1928, *Grant 3804* (P); near Robertson, 30 Sept., 1929, *de Wet 4938* (NH, P); Riversdale, date lacking, *Rust 114, 226* (B); mouth of Knysna River, Oct., 1921, *Fourcade 1491* (FH); Humewood, Sept., 1911, *Paterson 17* (A); Port Elizabeth, Sept., 1908, *Drege 268* (A); Port Elizabeth Valley, Aug., 1912, *Paterson 2315* (A).

An exceedingly variable species as to the size of the flowers, the amount of pubescence, the size and shape of the leaves, the length of the pedicels, and the size and shape of the corolla-sacs. The upper petioles are occasionally very short or the leaves may be subsessile as in Ecklon's collection, the type of *H. sessilifolia*. But even on the type sheet of this species only the pair of leaf-like bracts is sessile. The size of the leaves varies greatly, apparently in direct relation to the amount of water and shade available. In moist shaded places, the plants are usually much larger in every way and generally more villous. This is well shown in *Grant 4843*, collected in Namaqualand. Typically the leaves are serrate or dentate, but on some specimens they are almost entire and on others, coarsely crenate.

2a. var. **pachyceras** (Diels) Grant, comb. nov.

Hemimeris pachyceras Diels in Engler's Bot. Jahrb. **44**: 121. 1909.

Corolla sacs broader and longer than in the species, varying from 1.5–2.0 mm. long and nearly as broad.

Distribution: in sandy areas or rocky places from Malmesbury District to Namaqualand and east to Mossel Bay.

CAPE PROVINCE: Moorreesburg, Nov., 1884, *Bachmann 722* (B); Olifant River Mts., 30 Aug., 1894, *Schlechter 5088* (K, B, Gen, A); Karree Berg, 23 July, 1896, *Schlechter 8289* (K, B, US, F, Gen, P, MBG); Namaqualand, without definite locality or date, *Scully 8* (K); southeastern slopes of Roepmyniet, 15 Sept., 1900, *Diels 1168* (B, TYPE of *H. pachyceras*); Calvinia, Sept., 1900, *Pritzel* (B); in hills,

Oorloogskloof, Onder Bokkeveld, 21 Aug., 1897, *Schlechter 10944*, in part (B, K, A, Gen, US, MBG); Vogelfontein, 14 Aug., 1896, *Schlechter 8517* (A, Gen, P, US, MBG, K, B); Gnagas Pass between Middlepost and Ceres, 28 Sept., 1929, *Grant 4916* (BH, P, MBG); foothills of Verlaten Kloof, Oct., 1920, *Marloth 9622* (M); among cliffs on Sneuwkraus, Farm Uitkyk, date lacking, *Marloth 9729* (M); in sandy places in Nieuwkloof near Tulbagh, Oct., 1886, *MacOwan 821*, in part (B, A, G); Barrydale, Oct., 1897, *Galpin 4356* (A, K); mountain ridges along lower part of Zonder Einde River, date lacking *Zeyher 3477* (K, B); Mossel Bay District, Klein Berg, 25 Sept., 1897, *Galpin 4355* (K).

There is every gradation possible between this and the species, which makes specific separation impossible. The most nearly consistent difference is the size of the corolla-sacs, and even this varies as may be seen in *MacOwan 821* and *1768, Marloth 12942, Andreae 428, Schlechter 8517* and *10944, Rust 226,* and *Grant 4869a.* In the last, corollas may be found in which the sac is broad and shallow or almost spurred. The nearly entire leaves of the plant on the type sheet are duplicated in many specimens, having the short sacs typical of the species. The ovary is papillose in some specimens and not in others in both the species and the variety.

3. **H. centrodes** Hiern in Th.-Dyer, Fl. Cap. **4**²: 167. 1904.
Hemimeris nana Diels in Engler's Bot. Jahrb. **44**: 121. 1909.

A glandular and viscid-pubescent annual, 10–30 cm. high, simple or more commonly branched from at or near the base, stems quadrangular, relatively stout; leaves opposite, ovate or elliptical, obtuse, coarsely and bluntly toothed, sometimes pinnatifid, rarely shallowly dentate, 2–4 cm. long, 0.5–1.0 cm. wide, base cuneate, petioles as long as or shorter than the blade, the uppermost leaves occasionally subsessile, internodes usually longer than the leaves, sometimes with smaller leaves fascicled in the axils; inflorescence racemose, often with several flowers having much shortened internodes clustered at the apex, and axillary flowers lower on the stem; pedicels rather stout, 1.5–4.0 cm. long, frequently deflexed in maturity, bracts linear or oblong, irregularly dentate with scattered teeth; calyx-lobes unequal, ciliate, ovate, oblong, or elliptical, obtuse, 4–6 mm. long, the uppermost lobe larger than the others and rounded

at the apex; corolla yellow, pubescent without, 0.8–1.5 cm. long, the upper lip 2.0–2.5 mm. long, erect, emarginate, with an incurved margin and 2 dark brown spots on either side of the center, lateral lobes rounded, about 2 mm. long and wide, densely maculate with sessile glands near the base and with ascending pockets projecting over the spur, middle lobe broadly rounded, 4–6 mm. long, 5–7 mm. broad, spurs 2, broadly obconical, nearly parallel for most of their length, incurved, blunt at the apex, 5–7 mm. long, 2–3 mm. broad at the base; stamens erect, shorter than the upper lip, filaments with broad membranaceous wings, anthers large, subglobose or oval, about 1.5 mm. long; ovary minutely puberulent, style narrowly winged, stout, curved toward the lower lip and shorter than the ovary; capsule subglobose, 5–7 mm. long, exserted; seeds numerous, black, minutely papillose, sometimes with very narrow white wings.

Distribution: in sandstone regions in the mountains around Calvinia and south into the Sutherland and Laingsburg Districts.

CAPE PROVINCE: in Karroo soil, Calvinia, Sept., year lacking, *Leipoldt 936* (K); stony ground near Elandsfontein Farm on road between Calvinia and Middlepost, 28 Sept., 1929, *Grant & Theiler 4891* (K); Hantam Mts. west of Calvinia, 14 Sept., 1900, *Diels 643* (B, type of *H. nana); near Calvinia, 28 Sept., 1929, *Grant & Theiler 4889* (BH, K, P, MBG); Bokkeveld, 12–13 Sept., 1900, *Pritzel* (B); Onder Bokkeveld, in hills around Matjesfontein, 20 Aug., 1897, *Schlechter 10925* (K, TYPE, B, Gen, US, MBG).

This is the largest and showiest of the four species in the genus. At first sight, one might easily take it for a yellow-flowered *Diascia,* but the shape of the corolla and the number of stamens place it in *Hemimeris.* The brown spots on the corolla often are conspicuous.

4. **H. gracilis** Schlechter in Jour. Bot. **36**: 375. 1898; Hiern in Th.-Dyer, Fl. Cap. 4^2: 167. 1904.

Small slender, glandular-pubescent annuals, erect, simple or occasionally with weak branches from near the base, 6–20 cm. high, stems tetragonal, often conspicuously channelled, internodes usually longer than the leaves; leaves thin, ovate to oblong, broadly obtuse, dentate with a few shallow and blunt

teeth, or coarsely dentate with crenate teeth, sometimes practically entire, truncate, cuneate or cordate at base, 0.8–5.5 cm. long, 0.4–2.5 cm. wide, petioles slender, shorter or longer than the blade; flowers axillary in the uppermost leaves, often crowded toward the apex, the internodes being very much shortened; pedicels slender, frequently deflexed in fruit, 1.5–4.0 cm. long; calyx-lobes narrowly oblong to lanceolate, obtuse, unequal, 2–4 mm. long, the uppermost longer and broader than the others; corolla yellow, 4–6 mm. long, posterior lip short, concave, the upper part arched and more or less concealing the anthers, anterior lip longer, the lobes broadly rounded or truncate, the lateral lobes short, spurs 3–5 mm. long, widely divergent, conical, blunt, longer than the lower lip, throat short, gibbous; stamens erect, filaments winged, glabrous; style about as long as the ovary, 1–2 mm. long, glabrous, broadly winged, the wings wider than the style proper, stigma capitate, capsule subglobose, 3–4 mm. long, sparsely glandular-pubescent or glabrous; seeds numerous, papillate, oval, brown.

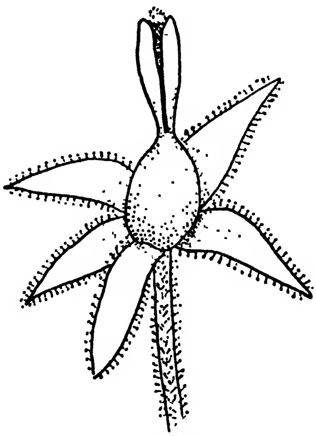


Fig. 3. *Hemimeris gracilis* Schlechter, calyx and pistil × 15.

Distribution: in sandy or rocky places from Van Rhynsdorp and Calvinia east to the Laingsburg District. Flowering from July until October or November.

CAPE PROVINCE: western slopes of Bokkeveld Mts., Oct., 1916, *Marloth 7662* (M); Oorlogskloof, Onder Bokkeveld, 21 Aug., 1897, *Schlechter 10971* (B, K, Gen, A, US, MBG); summit, Kubiskouw, on shaded krantzes under rocks, 8 Sept., 1926, *Marloth 12878* (M); in hills, Matjesfontein, Onder Bokkeveld, 19 Aug., 1897, *Schlechter 10918* (B, K, Gen, A, US); Hex River Valley, 14 Aug., 1896, *Wolley Dod 4010* (K); Hex River Valley, roadside 3 miles up from station, 14 Aug., 1897, *Wolley Dod* (B, TYPE).

DOUBTFUL SPECIES

Hemimeris bonae-spei L. Pl. Rar. Afr. 8. 1760.
Anagallis capensis L. Sp. Pl. ed. 1, 149. 1753, and ed. 10, 920. 1759.

SPECIES EXCLUDED

Hemimeris acutifolia Pers. Syn. Pl. **2**: 162. 1807. = **Alonsoa acutifolia** R. & P. Syst. Veg. 153. 1798.

Hemimeris caulialata Pers. Syn. Pl. **2**: 162. 1807. = **Alonsoa linearis** R. & P. Syst. Veg. 154. 1798.

Hemimeris coccinea Willd. Sp. Pl. **3**: 283. 1800. = **Alonsoa linearis** R. & P. Syst. Veg. 154. 1798.

Hemimeris diffusa L. f. Suppl. 280. 1781. = **Diascia diffusa** (L. f.) Benth. in Hook. Comp. Bot. Mag. **2**: 16. 1836, and **Diascia elongata** Benth. in Hook. l.c. 1836.

Hemimeris elegans Hiern in Jour. Bot. **39**: 102. 1901. = *Diascia* sp.

Hemimeris hirsuta Spreng. Syst. Veg. **2**: 809. 1825. = *Alonsoa* sp.

Hemimeris incisifolia Pers. Syn. Pl. **2**: 162. 1807. = **Alonsoa incisifolia** R. & P. Syst. Veg. 154. 1798.

Hemimeris intermedia Lodd. Bot. Cab. *t. 1456*. 1828. = **Alonsoa incisifolia** R. & P. Syst. Veg. 154. 1798.

Hemimeris linearifolia HBK. Nov. Gen. **2**: 377. 1817. = **Alonsoa linearifolia** Steud. Nom. ed. 2. **1**: 60. 1841.

Hemimeris macrophylla Thun. Nov. Gen. Pl. 76. 1784. = **Diascia macrophylla** (Thun.) Spreng. Syst. Veg. **2**: 800. 1825.

Hemimeris Mutisii HBK. Nov. Gen. **2**: 376. 1817. = **Alonsoa Mutisii** G. Don, Gen. Hist. **4**: 513. 1838.

Hemimeris parviflora HBK. Nov. Gen. **2**: 376. 1817. = **Alonsoa caulialata** R. & P. Syst. Veg. 152. 1798.

Hemimeris peduncularis Lam. Cycl. **3**: 105. 1789. = **Diascia diffusa** (L. f.) Benth. in Hook. Comp. Bot. Mag. **2**: 16. 1836.

Hemimeris procumbens Pers. Syn. Pl. **2**: 162. 1807. = **Alonsoa procumbens** R. & P. Syst. Veg. 154. 1798.

Hemimeris unilabiata (L. f.) Thun. Nov. Gen. Pl. 78. 1784. = **Diascia unilabiata** (L. f.) Benth. in DC. Prodr. **10**: 257. 1846.

Hemimeris urticifolia Willd. Sp. Pl. **3**: 282. 1800. = **Alonsoa incisifolia** R. & P. Syst. Veg. 154. 1798.

Annals
of the
Missouri Botanical Garden

Vol. 25 APRIL, 1938 No. 2

OPTICAL AND CHEMICAL STUDIES ON THE GRANULES IN MICROSPORES OF TRADESCANTIA

FRANCIS O. SCHMITT
Associate Professor of Zoology, Washington University

AND G. T. JOHNSON
Washington University Fellow in the Henry Shaw School of Botany of Washington University

Introduction

In certain stages in the development of the male gametophyte of *Tradescantia,* granules approximately 1–3 μ in diameter are present in relatively large numbers (pl. 31, fig. 1). They were observed by Hofmeister (1848), and Baranetzky (1880) figured them in meiotic stages in four different species. Sax and Edmonds ('33) noted that they disappear during growth and that they are relatively solid rather than fluid or plastic in consistency since they are not readily deformed by pressure on the cover-glass, and do not coalesce on contact. The latter also found that heating causes the granules to disappear.

Except for the statement of Sax and Edmonds ('33) that the granules are not composed of starch (based on a negative iodine test and a failure to observe birefringence), no information is available as to their chemical constitution. Because these granules play a significant role in certain cell processes (Johnson and Peck, '37) such information is highly desirable.

Issued May 6, 1938.

The present investigation, undertaken at the suggestion of Dr. Edgar Anderson, is designed to furnish data of this sort.

Experimental Results

1. OPTICAL PROPERTIES

Since the optical analysis is applicable to fresh untreated cells and granules it was entered upon at the outset of the present investigation, not only in order to obtain information as to the molecular organization of the granules, but also with the hope that it might provide a criterion for their intactness in the subsequent chemical characterization.

Young microspores of *Tradescantia paludosa* were used, these being particularly suitable if separation from the tetrad has just taken place. Because of the extremely small size of the granules, the examination in polarized light requires a highly critical adjustment of conditions of illumination and compensation. We used a standard Leitz Model BM polarizing microscope and an intense source of illumination (Leitz Universal Lamp, bulb operated at five amperes). For clarity of definition of the polarization effects it is necessary to work with the polarizer and substage diaphragms stopped down to small apertures. Under these conditions each granule presents a clear-cut polarization cross between crossed Nicols, the dark arms of the cross being parallel with the planes of polarization of the polarizer and analyzer regardless of the position of the granule in the field (pl. 31, fig. 2). The latter fact was strikingly seen in fresh preparations where the granules were in continual Brownian agitation; it was demonstrated in fixed preparations by rotation of the stage.

In order to characterize the optical properties further it is necessary to determine whether the spherites are positively or negatively birefringent (for a discussion of the technique and interpretation of the polarization optical phenomena see Schmidt, '24, '34, '37). The gypsum-plate method is inapplicable in the present problem because the granules are too small and the birefringence is too weak to determine colors in the quadrants. The more sensitive Köhler rotating compensator

was therefore used, the retardation of the mica plate being $\lambda/20$. The compensator is inserted into the draw-tube slot and rotated until the field is maximally dark, the Nicol prisms being crossed. The granules then show the typical interference cross. Rotation of the compensator slightly to one side of this position causes one pair of the quadrants of the granule to become dark while the neighboring quadrants are bright. Rotation slightly to the other side causes the picture to become reversed; the quadrants which were previously dark are now light and vice versa. From the known optical characteristics of the compensator the spherites were shown to be positively birefringent.

Because of the small size of the spherites, it is difficult to deal with their optical properties quantitatively. When the microspores are immersed in water, compensation of the cross is attained by a rotation of only 4°–5° on the compensator dial; this would correspond to a retardation of the order of 3 to 4 $\mu\mu$. The diameter of the granules varies between 1 and 3 μ. On the assumption that the optical effects are due to a packing of crystallites with their optic axes (and probably also their long directions) oriented radially, the birefringence of the particles composing the granules may be calculated according to the method of Bear and Schmitt ('36, equation 11). Calculated in this way the birefringence is found to be of the order of magnitude of 0.005, a value not incompatible with the results of the following chemical characterization which indicates that the granules might be primarily of protein nature.

Immersion of the cells in balsam and in media of various other refractive indices, which was done in connection with the solubility experiments described below, shows that the form factor is relatively small, the birefringence being due primarily to intrinsic birefringence, a fact which might be expected from the apparently compact structure of the granules.

The polarization crosses, clearly visible when the optical conditions are satisfactorily adjusted, served admirably in the chemical work, not only to reveal the presence of the granules in unstained preparations but also as an index of the extent of action of the various reagents used. If the reagent had no effect on the optical phenomena it could have had little action on the

molecules, the organization and orientation of which give rise to the optical phenomena.

2. CHEMICAL AND PHYSICAL PROPERTIES

A. Microchemical Tests.—

In attempting to characterize the granules chemically, we first applied a series of microchemical tests which are more or less specific for certain groups in the proteins, carbohydrates, and fats. It was clear at the outset that such a search could be of value only if a positive test were obtained. Negative tests, while suggestive, are not conclusive because the granules are so small that unless the color developed is relatively intense it might escape detection. The tests proved uniformly negative and will therefore merely be listed briefly.

Lipoids: The granules are not stained by Sudan III and other fat-soluble dyes, nor are they blackened or even colored by osmic acid.

Proteins: The following tests for proteins or for characteristic amino-acid constituents of proteins were all negative: xanthoproteic, biuret, Millon, Raspail, Adamkiewicz, aldehyde, iodine, and lead-acetate sulphur. Certain of the tests are inapplicable to the granules as such, owing to the solubility of the latter in some of the reagents necessary for the test. For example, in applying the xanthoproteic test for protein and the Molisch test with alpha naphthol for carbohydrate, the concentrated acids dissolve the granules. Therefore, though the cell contents gave positive tests it is impossible to say that the dissolved granules were responsible rather than the constituents normally present in the protoplasm.

Carbohydrates: The following tests, based chiefly on the reducing power of carbohydrates, were all negative: Fehling's solution, iodine and potassium iodide with and without H_2SO_4, cuprammonia, chlorozinciodide, Mangin's iodine-calcium-chloride, Molisch with alpha naphthol and with thymol, ammoniacal silver nitrate. These tests were applied before and after attempted hydrolysis with 0.1 M. hydrochloric acid.

B. Enzyme Reactions.—

In the digestion experiments an objection may be raised that a negative result may simply mean that the enzyme, being a large protein molecule, may not be able to penetrate the cell wall and actually come in contact with the granules. To meet this objection, granules were also expressed from the cells and exposed directly to the action of the enzyme. The results of the experiments with diastase, pepsin, and trypsin are shown in table I.

TABLE I

THE EFFECT OF AMYLOLYTIC AND PROTEOLYTIC ENZYMES ON THE POLLEN GRANULES OF *TRADESCANTIA*. TEMP.—30° C.

Enzyme preparation	Effect on granules		
	after 48 hours	after 1 week	after 2 weeks
Diastase (sat. aq. sol.)	—	—	—
Pepsin (1% sol. in 0.1 N HCl)	—	—	—
Trypsin (1% aq. sol. pH 7.4)	+	+	+
Trypsin (1% aq. sol. pH 7.4, heat inactivated)	—	—	—

The symbol — means that the granules remain unaffected in shape and in appearance in the polarizing microscope; + means that the granules have been completely digested.

The tryptic digestion of the granules is relatively rapid and complete. Whether the negative results with pepsin mean that partial proteolysis is possible without interference with the state of aggregation of the granules, or that the material consists of relatively small molecules, is not clear.

C. Solubility Properties.—

To test the solubility of the granules in reagents the microspores were immersed in the solvents on slides and coverglasses waxed to the slides to prevent evaporation of the solvent. The slides were examined from time to time with the polarizing microscope, and the appearance and optical proper-

ties of the granules noted. Between the readings the slides were kept at a temperature of 25° C.

Organic Solvents: The granules were unaffected both in appearance and in optical properties by exposure for as long as two weeks to any of the solvents tried; these included ethyl alcohol, n-butyl alcohol, benzene, chloroform, ether, acetone, carbon bisulphide, and xylene. Similar results were obtained with mixtures in various proportions of benzene-alcohol, ether-alcohol, and xylene-alcohol, at various temperatures (see table II). This clearly rules out the possibility that lipoids enter into the structure of the granules to any significant extent.

Acids and Alkalies: Of importance in determining the general chemical nature of the granules is the action of acids and alkalies. It was found that while concentrated mineral acids readily dissolve them, they are not visibly affected by dilute mineral acids (0.1 M. HCl, HNO_3, $HC_2H_3O_2$, and H_2SO_4). On the other hand, 0.1 M. alkali ($NaOH$, NH_4OH) dissolves them almost completely in ten minutes and completely in thirty minutes. KOH seems to be effective only in slightly higher concentrations (0.5 M.). The process of dissolution and destruction of birefringence of the granules was readily observable under the polarizing microscope; there is no possibility that the granules were simply released from the cell by disruption of the cell membrane. On the assumption that the granules are primarily protein in nature, this effect is easily understandable, for alkali is well known to promote solution of certain proteins and by hydrolysis to cause certain relatively insoluble proteins to become soluble. Alkali is also known to have a destructive action on the birefringence of protein micelles and aggregates (Muralt and Edsall, '30). The fact that most mono- and disaccharides are soluble in dilute acid solutions, whereas the granules are not, is evidence against their being of a simple carbohydrate nature.

Urea: The granules do not dissolve even after long standing in water or dilute salt solutions (0.5 M. $NaCl$). However, in strong urea solutions they disappear with great rapidity. In a

typical experiment the cells were first examined in water and the presence of the granules with polarization crosses demonstrated. The urea solution was then applied. Almost before the cover glass could be adjusted and the microscope focused upon the cells, the granules had disappeared. This is not due to an optical effect, the similarity of the refractive index of the granules and the urea solution making them invisible, for in other media of similar refractive index the granules with polarization crosses were plainly visible. Moreover, the cells were subsequently stained with acetocarmine which, by staining the cytoplasm, brings out the non-staining granules more clearly; in none of the urea-treated cells could granules be demonstrated. Half-saturated solutions cause disappearance in ten minutes; lower concentrations are relatively ineffective. So long as the granules are visible in urea solutions they show a positive polarization cross.

It is known that even relatively insoluble denatured proteins are soluble in urea solution (Anson and Mirsky, '31) and that the birefringence of protein micelles may be rapidly destroyed by urea (Muralt and Edsall, '30; Bear, Schmitt and Young, '37). The action of urea therefore might be considered as further indirect evidence of the possible protein nature of the granules.

D. The Effect of Heat.—

Sax and Edmonds ('33) noted that the granules disappear on heating (no details of the temperature were given). Because of the possible bearing of the thermal data on the chemical identification, the effect of heat on the properties of the granules in a variety of media was studied. The microspores were placed on slides in the appropriate media, cover-glasses waxed on, and the slides put in a thermostated chamber, the temperature being held constant to ±1° C. After variable periods they were examined both with the ordinary and with the polarizing microscope. The data are summarized in table II. Each symbol in the table represents the effect of treatment for 24 hours at the given temperature, twenty separate determinations being made for each temperature and each medium. Ordinarily the

granules go into solution between 50° and 55° C., although there is some variability in the results and in a few instances the granules did not dissolve until boiled. No attempt was made to determine the destruction temperature with any great accuracy.

TABLE II

THE EFFECT OF TEMPERATURE ON THE GRANULES IN THE MICROSPORES OF *TRADESCANTIA*

Immersion medium	Temperature					
	35°	40°	45°	50°	55°	60°
Water	–	–	+	+	+	+
Formalin (10%)	–	–	–	–	+	+
0.1 M. HNO_3	–	–	–	–*	+	+
Alcohol (95%)	–	–	–	–	+	+
Benzene	–	–	–	+‡	+	+
Xylene	–	–	–	–	+	+

The symbol – means that the granules remain unaffected; + means that they have disappeared. There was some variation in the results, but in only two cases was this greater than 20%. * denotes a 35% exception and ‡ 40%. In the case of solvents immiscible with water the microspores were first dehydrated with absolute alcohol.

In water the granules become gradually more transparent and lose their spherical shape between 45° and 50° C. At somewhat higher temperatures they disappear completely. At temperatures slightly below their destruction temperature the bodies showed slight birefringence but no polarization crosses, possibly indicating that the original symmetry of packing of the ultraparticles had been destroyed.

Perhaps the reason why the granules of these microspores have received so little attention among cytologists is their apparent non-stainability. None of the stains used by us (safranin, fast green, methyl blue, acetocarmine, etc.) were effective, except to increase the contrast by staining the cytoplasm, the unstained granules then appearing clearly.

Another reason for the failure of the granules to appear in histological preparations is their sensitivity to heat. Except

under certain conditions, the temperature of the imbedding oven is sufficiently high to insure their destruction. It is known that certain cytological fixatives considerably increase the temperature necessary to produce shrinkage and disorganization of the protein components of certain tissues (Schmitt and Wade, '35, p. 173). To test whether fixatives tend to protect the granules against heat, anthers were placed in the following for two days: 10 per cent formalin, alcohol, and formol-acetic-alcohol. At the end of this period they were placed in the imbedding oven at 55° C. for two days. They were then removed, washed free of the fixative and the microspores examined for granules. In each case the granules were present in approximately unchanged shape. On the other hand, such material, when imbedded in paraffin and sectioned, showed no granules. The explanation of this is not clear but the best method for histological study appears to be fixation, followed by staining, running up through the alcohols and xylol, and mounting in balsam.

Summary

1. Studies have been made of the chemical and optical properties of the granules found in the microspores of *Tradescantia* in order to furnish a basis for an analysis of the role of these granules in cell function.

2. With critically adjusted optical conditions, viewed between crossed Nicol prisms, the granules present a positive spherite cross. This phenomenon has been tentatively interpreted as indicating that the granules are composed of fairly birefringent micelles oriented with optic axes radially disposed. This optical property serves admirably, not only as a criterion for the presence of the granules in unstained preparations, but for the intactness of their ultra-structure as well.

3. Microchemical tests for lipoids, carbohydrates, or proteins were inconclusive.

4. Trypsin effectively digests the granules, but pepsin and diastase are without effect.

5. Solubility data further limit the possibilities which need be considered with regard to their chemical composition. Pro-

longed extraction with a variety of lipoid solvents and of mixtures of solvents has no effect on the appearance and birefringence of the granules. They are insoluble in water, salt solutions, and dilute mineral acids but soluble in dilute alkali. The granules disappear rapidly in strong urea solutions.

6. Heating in water causes the granules to disappear in the approximate temperature range of 45°–50° C. Certain reagents, particularly certain cytological fixatives, increase the destruction temperature considerably. The possible significance of this for the histological investigation of the structures is pointed out.

7. The results so far obtained are best understood on the supposition that the granules are composed primarily of protein.

Literature Cited

Anson, M. L., and A. E. Mirsky ('31). The reversibility of protein coagulation. Jour. Phys. Chem. **35**: 185–193.

Baranetzky, J. (1880). Die Kerntheilung in den Pollenmutterzellen einiger Tradescantien. Bot. Zeit. **38**: 241–248, 265–274, 281–296. *1 pl.*

Bear, R. S., and F. O. Schmitt ('36). The optics of nerve myelin. Jour. Optical Soc. Amer. **26**: 206–212.

————, ————, and J. Z. Young ('37). Investigations on the protein constituents of nerve axoplasm. Roy. Soc. London, Proc. Ser. B. Biol. Sci. **123**: 520–529.

Hofmeister, W. (1848). Ueber die Entwicklung des Pollens. Bot. Zeit. **6**: 425–434. *1 pl.*

Johnson, G. T., and R. E. Peck ('37). Observations on the development of the male gametophyte in certain monocots. Ann. Mo. Bot. Gard. **24**: 161–174. *1 pl.*

von Muralt, A. L., and J. T. Edsall ('30). Studies in the physical chemistry of muscle globulin. IV. The anisotropy of myosin and double refraction of flow. Jour. Biol. Chem. **89**: 351–386.

Sax, K., and H. W. Edmonds ('33). Development of the male gametophyte in *Tradescantia.* Bot. Gaz. **95**: 156–163. *1 pl.*

Schmidt, W. J. ('24). Die Bausteine des Tierkörpers in polarisiertem Lichte. xii + 528 pp. Bonn.

————, ('34). Polarisationsoptische Analyse des submikroskopischen Baues von Zellen und Geweben. Abderh. Handb. biol. Arbeitsmeth. **5**[10]: 435–665.

————, ('37). Die Doppelbrechung von Karyoplasma, Zytoplasma und Metaplasma. Protoplasma-Monogr. **11**. xii + 388 pp. Berlin.

Schmitt, F. O., and L. J. Wade ('35). Solvation and desolvation of nerve. Amer. Jour. Physiol. **111**: 169–176.

Explanation of Plate

PLATE 31

Fig. 1. Photomicrograph of the microspores of *Tradescantia paludosa* in ordinary light, showing some of the refractive granules. Acetocarmine smear preparation. × approx. 725.

Fig. 2. Photomicrograph of a microspore of *Tradescantia paludosa* between crossed Nicol prisms. Note that each granule presents a clear-cut polarization cross, the dark arms of the cross being parallel with the planes of polarization of the polarizer and analyzer. Acetocarmine smear preparation. × approx. 910.

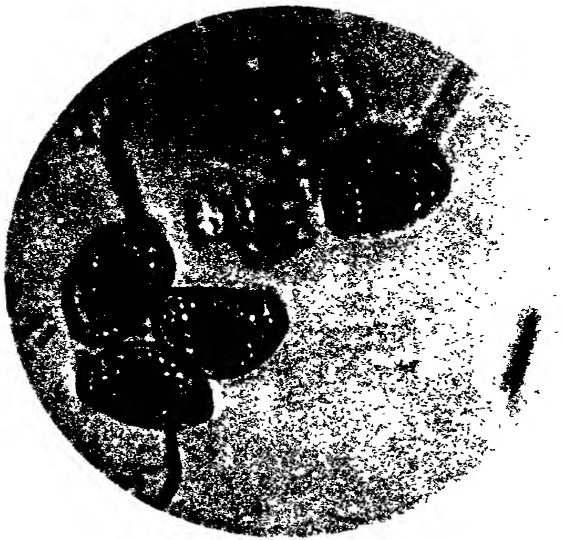


Fig. 1

Fig. 2

SCHMITT AND JOHNSON — MICROSPORE GRANULES

THE SECOND BYRD ANTARCTIC EXPEDITION—BOTANY

I. Ecology and Geographical Distribution

PAUL A. SIPLE

Biologist, Second Byrd Antarctic Expedition

INTRODUCTION

The Marie Byrd Land Exploring Party of the Byrd Antarctic Expedition II returned after a three-months' intensive sledging journey to the expedition's base, Little America, in December, 1934, with an unusually large collection of mosses, lichens, and algae, native to the nunataks of that land. The location of Marie Byrd Land makes the collection of plants especially interesting, because of its high latitude, often regarded as an area beyond the limits of plant life. The collection is the largest which has been made south of the 70th parallel and includes at least seven species found by the Queen Maud Geological Party of the same expedition, three of which were growing as close as 237 miles from the South Pole at an elevation of more than 2000 feet.

The purpose of this paper is to discuss the geographic factors affecting their distribution and floristic affinities. The flora of the Antarctic is noted for its extreme paucity in forms, and the collections of specimens which have heretofore been made were in general more a matter of chance than of purposeful research and exploration.

The history of Marie Byrd Land dates from December 5, 1929, when Rear Admiral Richard E. Byrd (at that time Commander), U.S.N. retired, was leading a large American expedition to the Antarctic. During one of his historical flights along the coast to the east of his base camp, Little America, located in the Bay of Whales in the Ross Sea he discovered a land hitherto unknown and unclaimed. The British claim to the Ross Sea Dependency extends to the 150th meridian of west longitude, so

Issued May 6, 1938.

that as he flew to the eastward from this meridian he was not only penetrating an unexplored land but an area which had not been previously claimed by any nation. Southward high elevations indicated snow-covered land, and just beyond the 150th meridian he sighted coastward rock exposures, the first he had seen since leaving the Rockefeller Mts. of King Edward VII Land, which had also been one of his discoveries earlier in the year.

As the peaks appeared on the horizon they were duly photographed and eventually located upon a reconnaissance map of the new land. The mountain systems he named the Edsel Ford Ranges, and the land was named in honor of the Commander's wife, Marie Byrd. Since conditions were impracticable for landing, field work could not be carried on within any of the mountains on the coastward end of this land to the north. Thus it remained the work of a second Antarctic expedition, again under the leadership of Admiral Byrd, in 1933–1935, to explore the new land.

Marie Byrd Land, a great triangular wedge with its apex at the South Pole and its base on the ice-guarded coast of the Pacific Ocean, is bounded on the west by the 150th meridian of west longitude and stretches eastward through twenty or more degrees of longitude. It lies almost midway along the coast between the two best-known sections of the Antarctic, Graham Land to the east, and South Victoria Land to the west. Its position, without known land bridges and facing along one of the broadest islandless sections of the Pacific Ocean, becomes more important in view of the fact that Graham Land and South Victoria Land are very different in their geological structure. Obviously they are not parts of one physiographic unit and some significant geomorphologic changes have taken place within the snow-covered expanse lying between them. Thus mid-position in the questionable area establishes the potential importance of the newly discovered coastal mountains of Marie Byrd Land.

The location of Marie Byrd Land also is of interest to botanists, for extensive collections of Antarctic mosses and lichens of the continent proper had been gathered only in Graham Land and in South Victoria Land. In the latter, certain affinities

were found to the lichens and mosses of Australia and New Zealand, while in the former some of the specimens were associated with those previously collected in South America, affinities which from their geographical location appear logical. However, the species of either region show little in common with those of the other. What characteristics of plant life might be exhibited in the land lying between these two more open sections of the Antarctic? The answer to this pertinent question became one of the major aims of the field party, part of the program of the second Byrd Antarctic expedition, which penetrated the territory on foot.

The writer was a member of the first, and of the second, Byrd Antarctic expeditions, and on both occasions was connected with the Biology Department. On the first expedition he served as nature observer in the vicinity of Bay of Whales. On the second expedition he was placed by Admiral Byrd in charge of organizing the Biology Department. Three full-time observers and one assistant formed the department, and in plans proposed it was agreed that the writer, because of his previous Antarctic experience, should be permitted to lead a small party into the coastal mountains to the east for special biological observations and reconnaissance. Admiral Byrd not only granted permission but recommended enlargement of the plans into one of the major field parties of the expedition.

Thus the Marie Byrd Land Exploring Party began. Associated with the writer on the adventure were F. Alton Wade, as Geologist, and Stevenson Corey and Olin Stancliff, as assistants and dog drivers. The party left Little America on October 14, 1934, and returned on December 29 of the same year. The men traveled on skis beside their three dog teams, later combined into two larger teams, which dragged on sledges all the equipment and food of the party.

The complete objectives of the party included: first, mapping the mountains by triangulation and solar fixes for ground control of the aerial photographic map which was to be constructed later; second, geological and glaciological study of the land; third, biological survey of the regions visited; fourth, magnetic observations wherever practical; and last, meteoro-

logical observations which would also serve by radio communications as guide to flying conditions when exploratory flights were projected eastward from Little America.

A chronological history of the trail journey is recorded elsewhere and need not be included.[1] The accompanying map shows the route taken by the party, and the following discussions include notations on the general conditions encountered. The journey was undertaken entirely in daylight, for only on nights of the first week or so did the sun dip below the horizon at midnight. Temperatures ranged from about –40° F. to 34° on extreme occasions, but averaged about zero or above during the entire journey. Aside from the loss of three dogs no casualties of serious consequence occurred.

The biological program of the party covered several distinct phases. The results of zoological observations included one new rookery of snowy petrel on Mt. Helen Washington in the Rockefeller Mts. of King Edward VII Land, and a skua gull retreat on Skua Gull Peak. The microbiological work included many aseptically-taken samples of rock, plants, snow, stagnant water, mud, etc., from which many colonies of bacteria and moulds have been separated for identification; and in samples of ice and water numerous infusoria, rotifers, water bears, etc. were collected and photographed by cinema and still microshots. The botanical phase of the work included the collection of mosses, lichens, and algae from as many locations as could be examined and from which specimens could be gleaned.

Plant specimens were collected by searching diligently on all exposures of rocks and in likely crevices wherever the party stopped. Typical pieces of each kind of moss or lichen were taken from each location where the form was found, and wherever practical with attached bits of the substratum the better to preserve the plant intact. In some areas density of plant life was too great to obtain more than random samples, while in other places where life was more sparse nearly every available

[1] Byrd, R. E. Discovery, the story of the second Byrd Antarctic Expedition. i–xxi, 1–405. illus. G. P. Putnam's Sons, New York, 1935.

Siple, P. A. Scout to explorer, back with Byrd in the Antarctic. i–xiv, 1–239. illus. G. P. Putnam's Sons, New York, 1936.

specimen was taken. The plants were placed in small wooden or cardboard boxes, and the more delicate specimens were individually wrapped in tissue paper. As the success of a polar trail usually depends upon concentration of the load of supplies, nearly every item at the start is reduced to a minimum to permit maximum amount of food (which determines the maximum length of stay in the field). The party had not been aware of the density of plant life, and consequently the supply of containers was scant. Less than a hundred small boxes were taken, and bags and other odd containers were borrowed from the galley equipment to help transport the unlooked-for richness of the finds. The collection was packed in a strong protective box and not disturbed to any extent until turned over to Dr. Carroll W. Dodge and to Mr. Edwin Bartram. Each box of specimens was labeled by its own serial number and by the number of the peak on which they were found, as corresponding to the survey of the unnamed mountains.

Simultaneously with the departure of the Marie Byrd Land Sledging Party to northwestern Marie Byrd Land, the Queen Maud Geological Party departed for similar reconnaissance in the mountains of southern Marie Byrd Land near the 150th meridian of west longitude between 85° and 87° of south latitude. Quin A. Blackburn, geologist, was leader of the party, ably assisted by Stuart D. L. Paine and Richard S. Russell, Jr. Although their interest lay principally in studying and mapping the geology of this region, they kept watchful eye for any plant life which might occur. It is to their credit that they engaged themselves so well in their search that they brought back at least eight different species of lichens so small as likely to have escaped any casual observer, but representing the most southerly existing flora so far recorded in the world, and indicating that these mountains support a far less luxuriant growth of plants than do the coastal ranges.

The success of the two major field parties could not have been achieved had it not been for sincere cooperation of the entire expedition. The technical staff at Little America helped in equipping the party and preparing the dogs, while supporting parties of dog teams and tractors materially aided by laying

depots of food supplies in early stages of the journeys. The Marie Byrd Land Sledging Party was particularly fortunate in having its depots laid as far as Mt. Grace McKinley and in having a thousand pounds of food laid down at that point by a Citroen tractor manned by Harold I. June, Kennett L. Rawson, and Carl O. Peterson.

PHYSICAL FACTORS AFFECTING DISTRIBUTION, AND SOME APPARENT ECOLOGICAL ADAPTATION

To understand better the conditions which permit a flora on Marie Byrd Land, it seems well to evaluate the environmental factors of the plants and to note some of their apparent adaptations to the rigorous conditions of their habitat.

Geological and glacial factors.—The mid-position of Marie Byrd Land, between Victoria Land to the west, Graham Land to the east, and the Queen Maud Mountains to the south, gave rise to most intriguing geological observations.

From rather meager data it is concluded that the sequence of geological events in the history of Marie Byrd Land was as follows: "deposition of a great series of arkosic sandstones and shales on the pre-Cambrian basement rocks, close folding of this sedimentary series accompanied by the deep-seated intrusion of acid magma, a long period of erosion, glaciation, and the extrusion of olivine basalt during the Pleistocene."[2]

The eroded coastal ranges are remnants of highly metamorphosed sediments resting as broken synclines upon massive intrusions of granites and eruptives, and show little definite relation to the Queen Maud Mountains to the south which are surmounted by lofty flat-lying beds of fossil and coal-bearing sediments. The rocks show a structural similarity to those of the Graham Land region to the east and an affinity in chemical composition to the ranges of South Victoria Land to the west but differing in most other respects from either.[3]

[2] Wade, F. Alton. Petrologic and structural relations of the Edsel Ford Range, Marie Byrd Land, to other Antarctic Mountains. Bull. Geol. Soc. America **48**: 1387–1395. *3 pl. 2 fig.* 1937.

[3] The geological references for this article have been supplied by F. Alton Wade, geologist Marie Byrd Land Sledging Party, by special notation and adaptations

The exposures along the coast appear as peaks recently emerged from the glacial ice-covering which caps the entire continent of Antarctica. Extensive areas of fracture suggest that the ice, relieved of its pressure near the coast, is dropping rapidly into the sea and exposing the coastal peaks. South of the coast the snow mantle rises until it inundates all the highest peaks and continues at an increasing elevation toward the Queen Maud Mountains which again thrust their loftier summits through the snow cover. Whether or not the land is continuous is one of the most hotly disputed questions regarding the structure of the Antarctic, and satisfactory proof remains yet to be elicited by sonic depth soundings.

The Edsel Ford Ranges of Marie Byrd Land are coastal. However, they assume the character of inland peaks because they are included within great fields of shelf and pack-ice frozen out into the ocean, and many of the peaks are 50 and 100 miles from the nearest open leads of water and hundreds of miles away from the nearest ice-free seas. The peaks have been heavily glaciated by over-riding continental ice pushed seaward from the center of the continent, as indicated by empty cirques, hanging valleys, glacial striae, and many other features of erosion and morainic deposition, now revealed above the ice. Recent retreat has lowered the ice level along the coast until the peaks have emerged as nunataks.

It is thus apparent that until recently ice covered the entire land, even eroding the highest pinnacles until no vestige of residual soil or plant life remained on them. Only the peaks are bare of ice, and support vegetation.

The accompanying table presents the petrographic description of the common rock types and mineral composition as determined by microscopic analysis. The fineness of grain of the sedimentary metamorphics has made analysis of them by this method impossible. Though chemical analyses are not yet available, description of the rocks is included.

from his doctorate thesis on the geology of Marie Byrd Land, at the Johns Hopkins University: "Northeastern borderlands of the Ross Sea: glaciological studies in King Edward VII Land and Northwestern Marie Byrd Land." Geog. Rev. 27: 584–597. *16 fig.* 1937.

CHEMICAL ANALYSIS OF SOME OF THE IGNEOUS MOUNTAINS IN THE EDSEL FORD RANGES OF MARIE BYRD LAND, COMPILED BY F. ALTON WADE

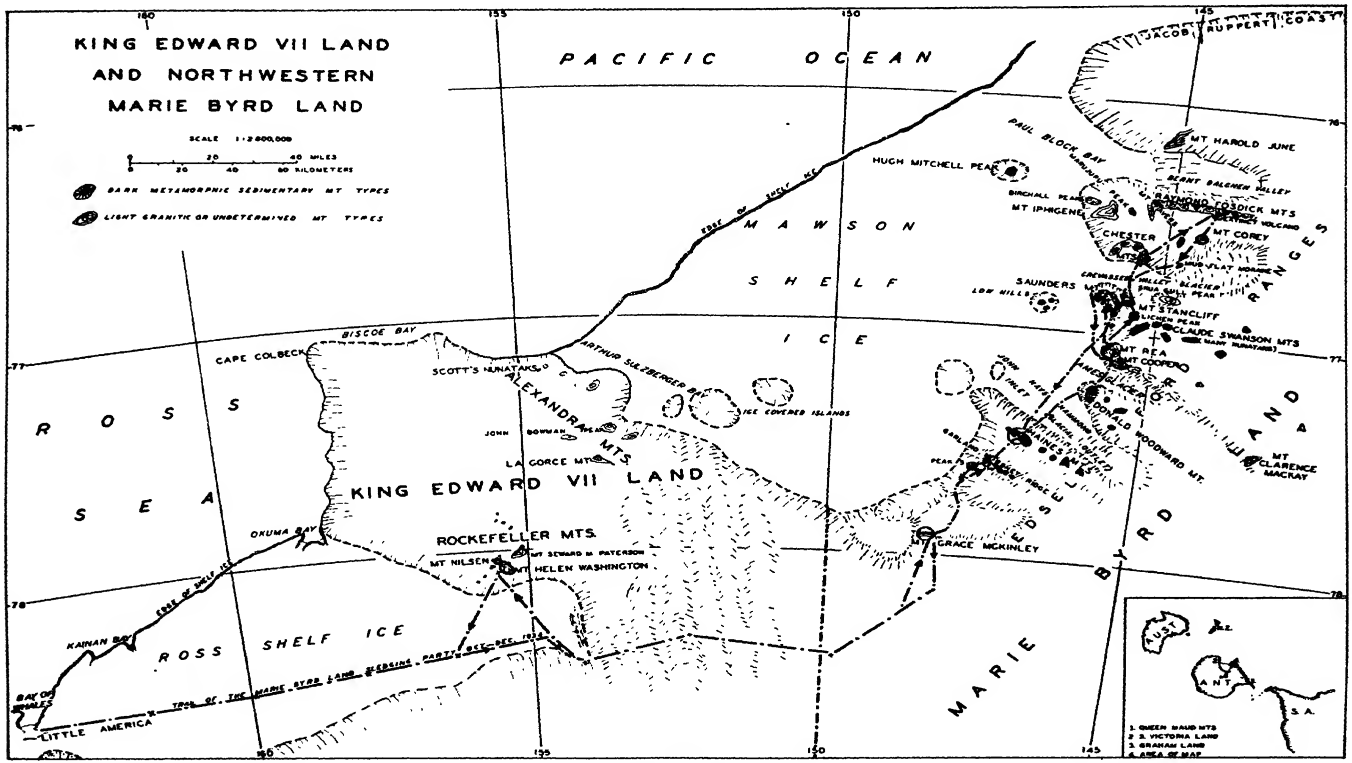
	1	2	3	4	5	6	7	8	9
SiO_2	74.	74.	41.	72.	67.	62.	66.	55.	68.
Al_2O_3	15.5	14.3	21.6	15.7	17.9	20.8	19.2	22.	17.3
K_2O	3.5	8.6		7.9	4.3	5.0	5.8	4.2	8.9
No_2O	6.7	1.2	2.6	3.1	2.7	3.4	3.1	4.1	4.0
CaO		1.4	9.5	0.42	3.6	4.2	3.5	5.6	0.4
M_gO			5.6	0.17	1.2	1.4	0.8	1.0	0.2
FeO		p*	9.0	0.17	2.6	2.5	1.4	3.2	0.3
Fe_2O_3		p	7.2		0.4	0.3		3.4	p
H_2O	0.13	0.08	2.7	0.07	0.4	0.4	0.2	0.3	0.06
P_2O_5	p*	p	p	p	p	p	p	0.6	p
CO_2			0.4		p	p			
Cl_2, F_2	p	p	p	p	p	p	p	p	p
ZrO	p	p	p	p	p	p	p	p	p

p* = present in very small amounts.

1 = Leuco-sodaclase granodiorite (gray granite), N.W. Ridge, McKinley.
2 = Leucogranite (coarse pink granite), McKinley.
3 = Porphyritic diabase (black dike), N.W. Ridge, McKinley.
4 = Leucogranite (pink granite), Rea.
5 = Granodiorite (gray granite), north peak, west side, Saunders.
6 = Granodiorite (gray granite), south peak, west side, Saunders.
7 = Sodaclase granodiorite (gray granite), S.E. exposure, Chester Mts.
8 = Granodiorite (massive central mass), Raymond Fosdick Mts. near Volcano.
9 = Leucogranite, Corey.

Several of the mountains exhibited on the surface of the rocks calcareous deposits which were collected as possible plant life, especially at Mt. Stancliff, Lichen Peak, and Skua Gull Peak, all rich in plant life.

The accompanying map portrays the general distribution of the dark metamorphic sedimentary peaks flanking the intrusive cores of contrasting light-colored granitic rock. As may be seen in the table, distribution of plant life in general seems to be a little denser on the darker mountain peaks


KING EDWARD VII LAND
AND NORTHWESTERN
MARIE BYRD LAND
SCALE 1:2,800,000
DARK METAMORPHIC SEDIMENTARY MT TYPES
LIGHT GRANITIC OR UNDETERMINED MT TYPES
PACIFIC OCEAN
ROSS SEA
ROSS SHELF ICE
MAWSON SHELF ICE
KING EDWARD VII LAND
MARIE BYRD LAND
ROCKEFELLER MTS.
ALEXANDRA MTS
EDSEL FORD RANGES
BISCOE BAY
CAPE COLBECK
SCOTT'S NUNATAKS
ARTHUR SULZBERGER BAY
ICE COVERED ISLANDS
OKUMA BAY
KAINAN BAY
BAY OF WHALES
LITTLE AMERICA
EDGE OF SHELF ICE
TRAIL OF THE MARIE BYRD LAND SLEDGING PARTY OCT.-DEC. 1934
MT NILSEN
MT HELEN WASHINGTON
MT SEWARD W PATERSON
LA GORCE MT
JOHN BOWMAN PEAK
MT GRACE MCKINLEY
HUGH MITCHELL PEAK
PAUL BLOCK BAY
MT HAROLD JUNE
BERNT BALCHEN VALLEY
RAYMOND FOSDICK MTS
MT IPHIGENE
BIRCHALL PEAK
CHESTER MTS
MT COREY
SAUNDERS MT
LOW HILLS
MT STANCLIFF
LICHEN PEAK
CLAUDE SWANSON MTS
MT REA
MT COOPER
DONALD WOODWARD MT.
HAINES MTS
MT CLARENCE MACKAY
JACOB RUPPERT COAST
AUST.
ANT.
S.A.
1. QUEEN MAUD MTS
2. S. VICTORIA LAND
3. GRAHAM LAND
4. AREA OF MAP

See page 503.

than on the granitic rock, due perhaps to the fact that darker rocks more quickly absorb the sun's heat and produce temperatures for the support of life over a longer period than do lighter-colored ones. The chemical analyses of the rocks are included to enable any reader who may be interested in this somewhat obscure factor in the life of the plant to gauge for himself its importance. Whether or not there is a direct connection between the distribution of the plants and the chemical analysis has not been proved. However, it is apparent that some species show preference either for granitic rock or for metamorphic types, that some are decidedly indifferent to rock composition, and some of either grow best where bird guano is present.

On Mt. Grace McKinley the plant life varied in color decidedly with the type of rock exposures, dikes, etc.; for example, two species of *Umbilicaria (U. rugosa* and *U. cerebriformis)* blended in color almost exactly with a dike of porphyritic diabase, while the coarse-grained granite of the mountain supported seven other species of lichens, including none of the above-mentioned species. Somewhat similar relationships will be noted in the discussion of distribution.

The writer was extremely surprised at the apparent effect of plant life in producing an unusual amount of disintegration of the rock. It led to the following note in his diary: "It would be surprising to know the relative disintegration by plant and by frost action at present. I should not be surprised to learn that they are nearly equal here where plants are almost unthought of."

Close search almost everywhere with a hand lens revealed tiny plants wedged in the inter-crystal cracks. When the crystals were separated by the point of a knife lichen thalli and algae were often discovered on the under-surface. In many places the rocks were so badly weathered that soil material had begun to form. Small pockets of sand and boulder clay in places supported growths of mosses and lichens; at other points the deposits were completely bare. Most generally the plants seemed to respond to localities where they were best protected from the wind and assured of some supply of melted

snow. In plate 33, fig. 2, and pl. 34, fig. 4, plant life is seen growing in small wind-excavated pits on a horizontal granitic surface at Mt. Grace McKinley. Such pockets caught a small quantity of snow which melted to temporary pools of water along whose margins *Alectoria antarctica* was afforded time to grow quite well.

Light.—The light regime through the whole of Antarctica is regulated chiefly by high latitude. The entire continent lies south of the Antarctic circle and the area from which plants were taken in Marie Byrd Land ranges from 76° 30′ to 86° 3′ of south latitude. Therefore a four to five months' period with continuous sunlight exists in summer, a similar period with no direct sunlight in the winter, and the remaining months transitional. While the maximum elevation of the sun is about 36° 30′ in the northern coastal ranges of Marie Byrd Land, it is only a little more than 28° at the apparent limit of southern growth of macroscopic plant life. The elevation of the midnight sun varies respectively in these same localities from less than 10° to 18°.

The extremely low angle of the sun's rays forces them to pass through great thicknesses of atmosphere with consequent elimination of much of their intensity. However, the unusually clear atmosphere of the polar regions, result of the reduction of moisture in the air by low temperatures, and the multiple reflections of the sun's rays across the white snow crystals producing some polarization, tend to compensate for the otherwise ineffective angle of the sun.

That certain light factors are reduced considerably was proved by the reaction of the photographic film used by the entire camp. Most of the film was super-sensitive panchromatic, for which the light-meter calculations indicated fabulously high speeds as compared with regions of lower latitude, but which required much wider apertures and slower speeds to prevent the continuous tendency to under-exposure. Some of the retardation of the film was no doubt caused by lower temperatures. However, the reaction was quite obvious at temperatures slightly below freezing.

The quality of the light through multiple reflection and even from diffusion through heavy clouds was so intense during the summer months that to go without satisfactory sun glasses for more than an hour or so meant a painful attack of snow-blindness. It even affected those wearing inferior glasses.

Two special adaptations which plants apparently made to Antarctic light conditions were unusually dark colors and selective distribution. Most lichens were decidedly black, while others were dark green, gray, brown, or red. Only few types exhibited light colors. In most cases these were of small size, which permitted them to utilize absorbed sun's heat indirectly from moss clumps or from dark rocks upon which they grew. In general their colors were much darker than those of more common lichens of warmer latitudes.

The second reaction, that of distribution, revealed itself in the lack of a specific pattern of orientation, i. e., the plants were not more common on the north side of mountains than on the south. Moreover, lichens were in many places found on the under side of rocks which received only reflected light. One striking example of this was at Mt. Rea-Cooper where a small cave, facing towards the south with a roof sufficiently sloping to allow moisture to run across it by adhesion, supported a luxuriant mass of *Parmelia*. As was true in most cases, this lichen was associated with a super-growth of a species of *Polycaulonia* or *Blastenia* which are red, branching forms, while *Parmelia* is flat and gray, extending usually over wider area than more brightly colored types.

Temperatures.—To study the factors of temperatures affecting the growth of plant life the meteorological records taken by Amundsen in 1911–12, and by Byrd in 1929–30 and again in 1934–35 are available.

The latitude of Little America corresponds approximately with the southern border of northern Marie Byrd Land and the weather regime of the two places may be assumed to be about the same, but tending to minimum rather than to maximum conditions in the latter. The mean yearly temperature as recorded in 1934 was found to be about –12.85° F., while the

mean maximum was but –3.23° F. and the mean minimum was sinking to –22.4° F. In contrast to the warmest temperatures recorded, the minimum was that of just below –72° F. which from the 1929 records and from Amundsen's figures would appear to be about average.

With return of the sun, temperature rises but there is an apparent lag of a month or more before temperatures become much higher. The mean temperature of the summer months, i. e., those months with continuous sunlight, is about 8.75° F. The two months receiving greatest insolation show a mean of 20° F. January is the warmest month with mean of nearly 24° F.

On eighteen days in 1929 and eleven days in 1934 the maximum temperature rose above freezing, while only on January 21 and 22, in 1929, were mean daily temperatures of 32° and 33° F. recorded. Ten unusually warm days continued from January 20 to 29, 1929, during which the maximum daily temperature was: 29°, 37°, 42°, 35°, 35°, 38°, 39°, 30°, 28° and 33° F. However, mean temperatures for these days were correspondingly as follows: 20°, 32°, 33°, 28°, 26°, 27°, 26°, 18°, 15° and 22° F., indicating, no doubt, such maximum heating of the air as occurs in regions with no rock exposures to absorb and to increase the heat by radiation. Very little melting takes place on the surface of the snow. Snowflakes change to crystalline névé and considerable ablation takes place, yet any dark objects lying on the snow usually sink down into it very rapidly, while the whiteness of the snow protects it, by reflection, from melting.

July, August, and September are the coldest months, with a mean of about –37.5° F. Even though each of these months has one or more days when the temperature rises to zero or above (days always accompanied by blizzards of föhn nature from the east), the monthly mean minimum temperature sinks below –48° F.

Diurnal temperature variations are marked but rather erratic. The Antarctic is characterized by its sudden changes in temperature, particularly in winter when it may rise or fall more than 50° within less than twenty-four hours. The coldest

periods are usually accompanied by calms and clear sky, the warmer periods generally by föhn-like blizzards from the east or southwest.

Only a short distance above the surface of the snow during the colder periods the temperature makes a rapid inversion, becoming much warmer by comparison, which might mean that the loftier mountain summits are subjected to warmer air and that their accompanying plant life is exposed to less rigorous minimum temperatures.

It seemed apparent to the observers in the field that as they progressed farther north in their journey through northern Marie Byrd Land the climate became milder. It was somewhat difficult to compare the meteorological records of the party with those at Little America, but they did show several degrees higher temperature on the average. It does not seem unreasonable to assume that in the northern exposures of Marie Byrd Land temperatures may average as much as 10° higher than at Little America, for almost uniform gradation was shown in the temperature records at the Bolling Advanced Weather Station, where Admiral Byrd spent the winter night alone, just south of the 80th parallel with a mean average of about 10° lower than Little America.

The Edsel Ford Ranges were from one to two degrees farther north than Little America, but, more significantly, they extended farther out into the sea, where maritime conditions had a moderating effect. Even though the sea is covered for many miles northward with great floes of heavy pack ice, the open leads of water not only tend to warm the air, but yield much moisture in the form of fog. The fog drifts in from the coast, and as it crystallizes and precipitates it must give off much latent heat which helps to moderate the coastal climate.

The Queen Maud Mountains to the south, however, probably have temperatures averaging from 10° to 30° lower than those to the north.

Additional evidence of milder climate in the mountains lying north of the 77° parallel of latitude was the occurrence of several extensive areas of so-called "blue ice lakes." One of these lay to the west of Lichen Peak and around the base of the

volcano. After returning to camp, melting of discolored ice from this place revived algae, infusoria, rotifers, and water bears. Mt. Helen Washington is also sheathed in glare ice, which cost the 1929 expedition one of its airplanes when the wind lifted it from its glassy moorings. The most striking example of milder climate was discovered on the summit of Skua Gull Peak, a peak so distinctly surrounded by a deep moat that it appeared to be nothing but a small rock until the depth of the trench was realized. The mountain was visited on December 4, before the warmest part of the year, and already very little snow remained on the surface. A low depression on the crest of the mountain served as a catchment basin for melted snow and formed a pond one or two hundred yards long and several inches deep, upon which a light crust of ice had formed (pl. 35, fig. 2). The bottom of the pond was full of ooze and foul-smelling muck, while the sides were encrusted with algae and bird remains. The little pond was nicknamed the "robbers' hang-out," from numerous evidences of skua gulls. Disgorged bones and feathers of the snowy petrel indicated that the scavenger skuas must come here to rest and digest their meals, but no direct evidence of nesting could be discovered, although there was no disputing that the peak had long been sanctuary to a multitude of the large birds. It is no small wonder that with milder climatic conditions, dark rocks absorbing more of the sun's heat, sheltered from wind, and enriched by bird droppings, plant life of this mountain surpassed all others in luxuriance, with possible exception of Mt. Helen Washington of King Edward VII Land, which was itself a rookery of snowy petrel. There again mildness of weather was evidenced by blue ice, although it is questionable whether the position of the mountain is one of great shelter from the winds that are prevalent there. Certainly it is a region of frequent fogs.

The sun's rays upon the rocks have strong heating effect. Black bulb readings have indicated temperatures as high as 120° F. It was often customary for travelers in the region to strip almost naked for comfort while skiing beside the panting dogs. Sunburn was as blistering on the men's faces as freezing had been a few weeks before. There were occasions when the

warm rocks invited a welcome siesta, and within the little orange-covered tents the heating effect of the sun was so great that a man was at times forced to lie on top of his sleeping bag instead of in it, even on occasions when the actual air temperature was well below freezing. A cloud over the sun immediately produced a sensation of chill.

Temperature conditions afford many occasions when plants may thrive for brief growing periods, but the plants must be adapted to unfavorable temperature changes any instant. In general, lichens seem to have many common characteristics which can be associated with their temperature surroundings, i. e., they have for the most part remained so small that they can hardly be noticed with the naked eye; their colors are usually dark to absorb the sun's rays more readily; further, the algal portion has remained buried deep within the structure of the plant. The mosses seem to have overcome most of their handicaps by their caespitose habit. They grew only on mountains which had most favorable conditions and were not found in the Queen Maud Mountains.

Wind.—Wind in the Antarctic promotes the loss of heat, abrasion of plant parts by drifting snow crystals, fracture of plant parts, and distribution of spores and asexual reproduction of the plants.

An area of "low" high pressure is recognized in the vicinity of the South Pole, a snow plateau about 10,000 feet high. As the pressure builds up in the center of the continent the air slides outward in anticyclonic spread. Northward moving air gains velocity as it reaches the coasts of the continent, and rotation of the earth deflects the air to the left, giving strong easterly component. The rush of air is intensified by the descending gradients along the radii of the domed continent, and in places, such as Queen Mary Land, the velocity may be as much as 150 to 200 miles per hour with a yearly mean of 50 to 60 miles per hour. However, on the surface at Little America no velocities of more than about 75 miles per hour were recorded. The outward flowing air is replaced by higher inflowing warm air from the northwest drawn downward to complete the circulation, and consequently even more heated and dried in accord-

ance with true aspect of adiabatically heated föhn winds. An area of constantly low pressure just off the coasts to the north over the warmer sea draws the air outward into the formation of a continuous procession of cyclonic storms moving constantly from the west to east just south of the area of predominant westerlies. Occasionally these cyclonic storms drift inland, carrying fog and snow with them, and often the upper air moving in above the continent brings in considerable quantities of heavy clouds.

Strong winds often drive quantities of sharp-pointed crystals of surface snow before them, little crystals which must often abrade the soft tissues of the plants like a sand blast if snow does not drift about them as protection. The driving wind often breaks loose whole sections of plants and hurls them across the snow, perhaps to other mountain tops where they may find convenient foothold to continue life. The path of outward blowing wind must have a strong bearing upon the distribution pattern of the plants asexually as well as by spores.

When lowest temperatures occur the weather is usually calm, as has been pointed out, and permits organisms to withstand cold that might otherwise be lethal. The warmth of the föhn wind brings a rise in temperature which may prevent excessive loss of heat by making the temperature gradient between the plant and its environment less steep. Men suffer most when air drains from higher slopes. Because of its density it tumbles downward like a cataract without time to warm up. These katabatic winds are usually local but may cause almost instantaneous freezing of the flesh. They are among the most painful factors encountered in polar climatic conditions. Plants of mountain tops may escape the frigid blasts because of their positions upon elevations above the snow fields, and may in places attain enough height to be in the path of the inblowing warmer winds.

Another response possibly due to wind is location of plant life in protected spots where it may be covered by drift snow in times of wind, snow which later serves as a moisture supply when melted by the sun on the heated rocks. Such plants as *Usnea* suggest tiny lignified trees and their branching and

flexibility allow them to withstand strong blasts of air. Most lichens exposed to strongest winds are so firmly attached to the rocks that they can hardly be removed without serious breaking. Spreading types clinging tight to the surface of the rocks are subjected only to ravages of existing snow, while the *Umbilicaria, Parmelia,* and related forms hold their flat thallus close to the surface of the rock, probably as much to profit from the warmth, to remain reduced in size and to conserve moisture, as to keep protected from the wind. The diminutive size of many species gives them small surface area, a primary protection against the wind.

Precipitation, evaporation and available moisture.—The relative humidity of the Antarctic coastal zone is often indicated by measurement to be quite high, but the absolute humidity is, of course, very low because of the inability of the cold air to hold much moisture in suspension. Vapor from the breath lingers for long periods in cold weather, and may be seen to sink slowly if the atmosphere is calm enough. At temperatures of –50° F. or below crystallization of the vapor becomes distinctly audible.

Often fogs of "sea smoke" rolling inland from the ocean hold moisture in such critical suspension that it is deposited as sheets of ice or crystals of hoar frost upon the first objects they meet.

It is almost impossible to measure precipitation exactly. High winds carry such quantities of loose drift along the surface that snow drifts several feet high may form in a few hours with or without any additional precipitation. Dr. Hobbs points out in his theory of glacial anticyclones that much precipitation must occur in the interior of Antarctica and Greenland by fine crystals dropping from cirri in the descending upper atmosphere. The adiabatic outward winds then cause a drying effect so that the edges of the continent may exhibit thinner coverings of snow and ice due to greater drying effect of the warmer, drier air. Some areas just in from the coast in Greenland do show similarity to desert country. However, if such conditions do exist undiscovered in Antarctica the area of the coastal ranges of northern Marie Byrd Land probably ex-

tends out into the marine influence sufficiently to receive more than the average amount of precipitation. Several heavy snow falls were experienced by the exploring party, and fogs as well as crystal deposition were common during the period of exploration.

Ablation and drifting are the chief methods of dispersion of the inland surface névé. It is only where dark rocks project that heating overcomes reflection and permits actual melting of the snow. Even so, the extension of watery areas is very small, for shortly after the water strikes the snow surface it freezes again. It is natural, as has been mentioned before, that plants are found growing most plentifully along avenues of small trickles of water where loose material has accumulated. Some of the little stones lying in the path of the intermittent water had as many as six to ten different species of lichens clinging to them.

Polar conditions are really those of a typical desert, and plant life must be able to adapt itself to them. Many small lichens, some almost microscopic in size, are bud-like in shape and resemble true succulent plants. Their small size requires little water to carry on growth and reproduction. Other large forms have hairy under-surfaces to aid in obtaining water. An adaptation of some types of lichens is to grow on top of moss clumps until the moss is no longer able to live. The dead moss plant, however, still holds much moisture, which remains available as though in a sponge, long after the surrounding rocks have dried up. Even moss plants take advantage of the older growths of dead leaves beneath to protect them and to provide a source of water. The greenest and most hardy-looking clumps of moss are those that have built up adequate supply of "undergrowth."

As has been mentioned, two of the mountain peaks which were most luxuriant in their floral display were host to bird inhabitants. It cannot be certain, however, whether it is the presence of the birds which has encouraged the more luxuriant growth of lichens, mosses, and algae, or whether the same climatic factors which have made these two mountains more desirable as a rookery than the neighboring peaks may not be

the most desirable also for plant growth. While Skua Gull Peak is host to transient McCormick skua gulls, probably because of the presence of a fresh-water pond well sheltered from the wind, the neighboring Lichen Peak, only about seven or eight miles away, is almost as rich in numbers of species even though it bears no evidence of bird life, and the wind has blown small rock fragments over the ice several miles to the west in veritable drifts that were hazards to the sledge runners of the field party. Saunders Mt. also serves as a retreat for McCormick skua gulls.

Mt. Helen Washington, the only collecting point in King Edward VII Land, was the breeding place of snowy petrel. However, from the numbers of birds circling about overhead it was likely that neighboring peaks also served as rookeries for both the snowy petrel and Antarctic petrel. In fact, Lieutenant Prestrud, of Amundsen's Norwegian Expedition,[4] visited Scott's nunataks and reported evidences of a bird rookery there as well as rather extensive presence of plant life.

Snowy petrel were seen flying over Mt. Haines, and during our absence from Mt. Grace McKinley a bird visited an exposed bacteriological plate, which proves that birds do frequent many of the peaks.

DISTRIBUTION OF PLANT LIFE

The detailed description of each species of lichen or moss gives the locality from which it was collected; therefore, the following discussion need deal only with generalities and description of individual peaks. The mountain peaks are grouped as metamorphic sedimentary mountains, or as granitic mountains, following the route of the trail journey from west to east.

METAMORPHIC SEDIMENTS AND ASSOCIATED DIKE ROCKS

Garland Hershey Ridge: 77° 38′ S.–147° 15′ W.—Three small exposures were visited in the ridge of nunataks lying between Mt. Grace McKinley and Haines Mts. The exposures are all

[4] Amundsen, R. E. G. The south pole: an account of the Norwegian Antarctic Expedition in the Fram, 1910–1912. Tr. A. G. Chater, London. J. Murray, 1912. [See 2: 395.]

low and apparently have only lately melted out of the ice-covering of snow. Only two species were found, both growing on orthoclase-sericite schist and dark gray slate.

Buellia grisea and *Lecidea Byrdii.*

Haines Mountains: 77° 30′ S.–146° 45′ W. (Pl. 33, fig. 4).—Much more extensive than Garland Hershey Ridge are Haines Mountains, but only the most northerly exposures, which probably yielded best growth conditions for plant life, were visited. Most of the mountain was composed of sericite schist which weathered with evidence of much iron. Exposures of orthoclase-sericite-siderite schist were characterized by square pits of dissolved minerals and extensive iron stains.

This was one of the regions of less dense growth and no mosses were found. *Alectoria antarctica, Buellia alboradians, B. floccosa, B. grisea, B. muscicola, B. pallida, B. stellata,* and *Usnea antarctica.*

Mt. Donald Woodward: 77° 18′ S.–145° 50′ W. (Pl. 36, fig. 5; pl. 37, fig. 4).—Of several scattered exposures lying between John Hays Hammond Inlet (outlet glacier) and Ames Glacier, Mt. Donald Woodward is the northernmost and largest. Better climatic conditions were revealed here by the first appearance of tiny clumps of moss and more numerous species of lichens, but the mountain had a sparse flora in comparison with the more northern peaks of the land. Much plant life grew over clumps of moss or on loose sandy loam, derived from the predominant rock type which was biotite-sericite schist.

Growing loose, easily detached, on clumps of moss or sandy loam: common—*Lecidea Siplei* and *Gasparrinia Siplei* (the only species found both on rocks and loose); occasional—*Catillaria floccosa, Lecanora griseomarginata, Parmelia leucoblephara, Pyrenodesmia Darbishirei, Usnea frigida. Grimmia Antarctici* and its var. *pilifera* were the only mosses found.

Growing on biotite-sericite schist: common—*Buellia flavoplana* (only on this mountain but described from S. Victoria Land), *B. grisea, B. stellata, Gasparrinia Siplei, Lecidea capsulata, Rhizocarpon flavum,* and *Thelidium inaequale;* occasional—*Alectoria antarctica, Buellia dendritica, Kuttlingeria rufa* (endemic), *K. rutilans, Parmelia leucoblephara, Polycauliona pulvinata, Protoblastenia alba* (endemic), and *Thelidium Caloplacae.*

Lichen Peak: 76° 55′ S.–145° 20′ W.—One of the numerous mountains of the Claude Swanson group, located just northeast of Mt. Rea-Cooper is Lichen Peak. Although subjected

to much wind, in places it exhibited luxuriant growths of plant life—mosses, lichens, and small, dark, irregular masses of algae resembling *Nostoc.* The mountain rises smoothly above the snow surface without the usual wind moat at the contact line. The surface of the mountain was broken into fine talus on the lee side, and rock chips were strewn for miles in drifts piled westward over the ice. The mountain is composed mainly of sericite-orthoclase schist, gray slate, and arkosic sandstone. Because the two latter types are more friable, fragments are easily plucked out by wind, and plant life is less abundant on them.

Growing on gray slate: *Lecanora lilacina, Lecidea Siplei,* and *Parmelia variolosa.*

Growing on arkosic sandstone: very common—*Usnea frigida;* common—*Lecidea capsulata;* occasional—*Blastenia grisea* (endemic) and *Lecidea Coreyi.*

Growing on sericite-orthoclase schist: very common—*Alectoria antarctica, Buellia frigida,* and *Candelariella albovirens;* common—*Lecidea capsulata, L. Coreyi, L. Stancliffi, Parmelia leucoblephara,* and *Usnea frigida;* occasional—*Buellia albida, B. alboradians, B. grisea, B. muscicola, B. stellata, Huea flava, Pannoparmelia delicata, P. pellucida* (endemic), *Protoblastenia alba, Rhizocarpon flavum, Sarcogyne grisea, Thelidium inaequale,* and *Umbilicaria spongiosa.*

Growing loose, easily detached, on moss clumps or on loose sandy loam: very common—*Alectoria antarctica, Catillaria floccosa, Lecidea Siplei, Protoblastenia flava,* and *Pyrenodesmia Darbishirei;* common—*Parmelia variolosa* and *P. Coreyi;* occasional—*Blastenia succinea, Buellia Siplei, Candelariella chrysea, Lecanora griseomarginata, L. lilacina, L. lilacinofusca,* and *Umbilicaria spongiosa.* The mosses were *Barbula Byrdii* and *Sarconeurum glaciale.*

Skua Gull Peak: 76° 50′ S.–145° 30′ W. (Pl. 35, figs. 2, 4; pl. 36, fig. 2).—This mountain mass, referred to several times in the preceding text because of the comparative luxuriance of its plant life (mosses, lichens, and algae), its odd formation surrounded by a deep depression, and the pond located upon its summit which is host to transient skua gulls, lies just two or three miles east of Saunders Mt. but is geologically of an altogether different origin. Mt. Stancliff is a larger and eastern exposure of the same mountain mass, and together they form a northern outlier of the Claude Swanson Mountains separated five or ten miles from the central mass of those peaks. While Mt. Stancliff appears to be sericite schist and fine-grained dike rock, there is more abundance of dark greenish gray slate on Skua Gull Peak, and also more of the

pitted orthoclase-sericite-siderite schist similar to that on the northern end of Haines Mts.

Growing on dark greenish gray slate: very common—*Gasparrinia Siplei, Lecanora griseomarginata, L. Siplei, Protoblastenia flava, Pyrenodesmia Darbishirei, Parmelia variolosa,* and *Umbilicaria cerebriformis;* common—*Blastenia succinea, Buellia dendritica, B. olivaceobrunnea, Catillaria cremea, C. floccosa, Parmelia griseola, Protoblastenia aurea, Thelidium Caloplacae,* and *T. parvum;* occasional—*Candelariella albovirens.*

Growing on orthoclase-sericite-siderite schist: very common—*Gasparrinia Siplei, Lecanora Siplei, Protoblastenia flava,* and *Usnea frigida;* common—*Buellia albida, B. olivaceobrunnea,* and *Thelidium Caloplacae;* occasional—*Buellia muscicola, Lecidea Siplei, Polycauliona pulvinata, P. sparsa, Rinodina sordida* (endemic), and *Umbilicaria rugosa.*

Growing on fine-grained dike rock: very common—*Alectoria antarctica, Gasparrinia Siplei, Lecanora Siplei, Polycauliona pulvinata, Pyrenodesmia Darbishirei, Umbilicaria cerebriformis, U. rugosa,* and *Usnea frigida;* common—*Protoblastenia aurea, Umbilicaria pateriformis,* and *Usnea antarctica;* occasional—*Biatorella arachnoidea, Buellia albida,* and *Lecanora carbonacea* (endemic).

Growing loose, easily detached, on clumps of moss, or on sandy loam: very common—*Gasparrinia Siplei, Lecanora griseomarginata, Parmelia Coreyi, Protoblastenia flava, Pyrenodesmia Darbishirei,* and *Usnea frigida;* common—*Alectoria antarctica* and *Blastenia succinea;* occasional—*Kuttlingeria rutilans, Lecidea Siplei, Polycauliona sparsa, Umbilicaria spongiosa,* and *Usnea antarctica.* The following mosses were collected: *Bryum antarcticum, B. Siplei, Barbula Byrdii, Grimmia Antarctici,* and *Sarconeurum glaciale.*

Mt. Stancliff: 76° 51′ S.–145° 20′ W. (Pl. 35, fig. 1).—Closely associated with Skua Gull Peak, a smaller twin nunatak lying immediately to the west, is Mt. Stancliff. It helps to shelter Skua Gull Peak from wind and is consequently not so rich in plant growth, but far surpasses Haines and Woodward Mountains. The mountain appears as a low nunatak from the west, but on the east it exposes a much bolder face as the ice drops away from it into the wide crevassed glacier valley. The beds of the mountain were less contorted and mostly composed of sericite schist and fine-grained dike rock. The plant collection was taken from the eastern end of the exposure. Mosses were present but not very plentiful.

Growing on sericite schist: common—*Lecidea capsulata* and *Rhizocarpon flavum;* occasional—*Buellia albida, B. floccosa, B. olivaceobrunnea,* and *Gasparrinia Siplei.*

Growing on fine-grained dike rock: common—*Rhizocarpon flavum;* occasional—*Polycauliona pulvinata* and *Huea flava.*

Growing on a single piece or erratic pink granite: occasional—*Alectoria antarctica* and *Sarcogyne grisea.*

Growing loose, easily detached, on clumps of moss or on sandy loam: occasional—*Lecidea Siplei* and *Protoblastenia flava*. Probably some species of *Usnea* occurred on this mountain but failed to be collected.

Granitic Mountains

Mt. Helen Washington: 78° 05′ S.–155° 20′ W. (Pl. 32, figs. 2, 3; pl. 33, fig. 5).—The mountain contacted last by the field party upon its return journey had previously been visited by Dr. L. M. Gould and party, as well as by Admiral Byrd who came to Gould's rescue when his plane blew away in a strong blizzard on the 1929 expedition. Time permitted for studying the region was cut short by the reduced food supply and by orders for the party to return to Little America. It was the only exposure visited in King Edward VII Land. A rookery of snowy petrel on the summit and frequent fogs and consequent milder climate furnish conditions for an extensive cover of mosses and lichens on every suitable location. Very recent subsidence of the ice is apparent from a distinct band above which *Usnea* is so dominant as to give the mountain of pink granite a blackish green tint, noticeable even from the airplane. However, below the line, which resembles a coastal high-water line, stretches a band of bare rock from 20 to 100 feet or more wide, comparatively free of *Usnea* or other growths. At the present contact between the snow cover and the bare rocks of the nunatak is a zone of melting, which when prodded by the point of a ski pole yielded fragments of bright green algae. Algae were in many places found matted on rocks and in tiny pools of water, which under the microscope revealed other small organisms. On the summit mosses and lichen forms usually associated with them were enriched by bird droppings, but *Usnea* and *Umbilicaria* grew luxuriantly, mainly because of milder climatic conditions. As stated before, the area surrounding the mountain is sheathed in glare ice. This is pitted by great accumulations of rock fragments which have melted into the surface but still show through. The mountain is composed mostly of coarse-grained pink granite with a few large crystalline quartz veins, and inclusions of highly weathered greenish granite in which orthoclase is dominant. Although

there was some variation in the distribution of plant life on different rock types, the differences are slight and may be due to irregularities in collecting. The mountain top was so plentifully covered that only a comparatively few of the specimens could be taken and identification in the field was impossible.

Growing on coarse-grained pink granite, coarse-grained pinkish leucogranite, white quartz crystals and quartzite, and weathered coarse-grained green granite: very common—*Alectoria antarctica, Candelariella albovirens, Protoblastenia flava, Umbilicaria cerebriformis, U. rugosa, U. cristata, U. pateriformis,* and *Usnea antarctica;* occasional—*Buellia dendritica, B. muscicola, B. olivaceobrunnea, B. Russellii, Catillaria granulosa* (endemic), and *Lecidea cancriformis.*

Growing loose, easily detached, on clumps of moss, or on chips of rock or sandy loam: very common—*Alectoria antarctica, Protoblastenia flava, Rinodina olivaceobrunnea, Umbilicaria rugosa, Usnea antarctica,* and *U. frigida;* common—*Buellia muscicola, Protoblastenia aurea,* and *Umbilicaria cerebriformis;* occasional—*Catillaria floccosa, Polycauliona pulvinata,* and a sterile yellow species found also on Mt. Grace McKinley. The mosses were *Bryum Siplei* and *Grimmia Antarctici* and its var. *percompacta.*

Eggshells, bones, and some rock surfaces were covered with dry patches of algae and abundant mosses.

Mt. Grace McKinley: 77° 55′ S.–148° 15′ W. (Pl. 33, fig. 2; pl. 34, figs. 2–4).—Mt. Grace McKinley, the most westerly exposure of Edsel Ford Ranges, was the first mountain visited, and a month later it was revisited on the return journey. Continental ice pushes up from the south and almost over the mountain, while the north side drops steeply with a cirque-cut face several hundred feet high. The mountain was not rich in its flora, principally because most of the rock exposed was vertical and inaccessible, and secondly, the slight evidence of melting around the exposures suggested that the temperatures were less favorable for plant growth than other mountains farther north in Edsel Ford Ranges. The western exposure appeared as a mere "peeping-through" of rocks, but actually the ridge was 20–50 feet wide and more than 100 yards long. Three types of rock appeared in the exposure—fine gray granite, pegmatite granite, and a highly weathered dike of porphyritic diabase; the latter displayed a distinct type of species which blended almost imperceptibly with the greenish color and texture of the rock. The main mass of the mountain is composed of coarse-grained pink leucogranite.

Growing on leucogranite (coarse pink granite): common—*Alectoria antarctica, Lecidea Coreyi, Protoblastenia aurea, Usnea frigida;* occasional—a sterile yellow species found also at Mt. Helen Washington.

Growing on leuco-sodaclase granodiorite (fine-grained granite) and crypto-crystalline pinkish granite near dike contact on west end of mountain: common—*Lecidea Coreyi* and *Usnea antarctica;* occasional—*Lecidea Stancliffi, Umbilicaria cerebriformis,* and a sterile yellow species found also at Mt. Helen Washington.

Growing on weathered dike of porphyritic diabase. Plants often growing loose or easily detached on small chips of rock. No other fine loose material occurred on the mountain except an apparently sterile pegmatite vein of quartz, beryl, and biotite. Common—*Umbilicaria cerebriformis* and *U. rugosa.*

Mt. Rea-Cooper: 77° 07′ S.–145° 30′ W. (Pl. 33, fig. 3; pl. 34, figs. 1, 5; pl. 35, fig. 3; pl. 36, figs. 1, 3; pl. 37, fig. 3).—Because it represents twin masses of the same mountain structure, divided by a narrow glacier-carved gap, this mountain is referred to by a double name. The mass was first sighted on the exploratory flight of December 5, 1929, and named Mt. Rea, which name now is applied to the northern exposure, while the southern is named Mt. Cooper. Actually the field party contacted Mt. Cooper for most of its observations, but knew both exposures as Mt. Rea. In early literature and geological publications description of both peaks was included under the name Mt. Rea, but here it seems wise to use both names. The mountains are composed of coarse-grained leucogranite which stands out in bold ice-carved relief with sheer cliffs rising 1000 feet or more. Conspicuous inclusions of stoped metamorphic rocks are often exhibited along the crest of the mountains, as are occasional dikes of granodiorite, etc. Most of the plant collection was made along the lower exposures, moraines, and talus slopes where access to the mountain was easiest. Many plants grew on stones in crevices where water trickled on warm days. Mosses were common but not so abundant as at Chester Mts., Mt. Helen Washington, Lichen Peak, or Skua Gull Peak.

Growing on coarse-grained leucogranite (light pink), also on coarse-grained granodiorite: very common—*Buellia brunnescens,*[6] *B. chrysea, B. dendritica,*[6] *Lecidea ecorticata,*[6] and *Rinodina sordida;* common—*Alectoria antarctica, Catillaria arachnoidea,*[6] *C. floccosa,* and *Usnea frigida;* occasional—*Buellia stellata, Catillaria*

[6] These species were found on no other mountain, but were relatively abundant on this mountain, which might suggest that such species may have a wider distribution than at present known.

inconspicua, Lecanora lilacina, L. subolivacea (endemic), *Lecidea capsulata,* and *L. Stancliffi.*

Growing loose, easily detached or on sandy loam formed from leucogranite: common—*Catillaria floccosa, Polycauliona pulvinata,* and *Protoblastenia flava;* occasional—*Blastenia succinea, Buellia (Diplotomma) Siplei, Huea flava, Lecidea Wadei, Parmelia variolosa, Rinodina olivaceobrunnea,* and *Thelidium parvum. Grimmia Antarctici* and its var. *pilifera* were the only mosses collected.

Saunders Mt.: 76°52′ S.–145°45′ W.—Saunders Mt., just north of the Rea-Cooper group, and the largest exposure of Edsel Ford Ranges, is composed mostly of coarse-grained gray granodiorite. The southern end, visited by the writer, was strikingly devoid of plant life. The western side, visited by Wade and Stancliff, yielded plant species typical of the larger conspicuous forms found at Mt. Rea-Cooper, including moss, *Usnea, Alectoria, Parmelia,* etc. This incomplete collection was carefully placed in a sterilized vial for bacteriological samples and was used for that portion of the biological survey. It is unlikely that there were any new or unusual species in the small collection. Disgorged bones and feathers gave evidence that skua gulls use the northern end of Saunders Mt. as a retreat, as they do at the neighboring Skua Gull Peak.

Chester Mts. (southeast peak): 76°40′ S.–145°20′ W. (Pl. 37, fig. 5).—One of the most northerly nunataks of floral importance visited by the field party was the southeast peak of Chester Mts. Although small, the exposure was the only one approachable from the south. Mosses appeared unusually green and fresh, and cushions were often several inches in diameter. Structure of the mountain, coarse-grained gray granodiorite with occasional quartzitic veins and other inclusions, was similar to that of Raymond Fosdick Mts. which neighbor it. Although the mountain was about thirty miles farther north than Mt. Rea-Cooper it had fewer plant forms, a condition possibly due to a south-facing stope in direct sweep of prevailing easterly blizzards.

Growing on coarse-grained granodiorite: common—*Candelariella chrysea* and *Catillaria floccosa;* occasional—*Alectoria antarctica, Buellia dendritica, B. frigida, Catillaria inconspicua,* and *Protoblastenia flava.*

Growing on quartzitic vein material: occasional—*Buellia stellata, Candelariella albovirens, Lecidea capsulata,* and *Sarcogyne angulosa.*

Growing loose, easily detached, on moss clumps or on sandy loam: common—*Candelariella chrysea* and *Catillaria floccosa;* occasional—*Parmelia leucoblephara.*

Mt. Corey: 77° 25′ S.–144° 35′ W. (Pl. 37, fig. 1).—Lying just south of the volcano of Raymond Fosdick Mts., Mt. Corey is a small exposure closely related to two neighboring exposures of coarse-grained pinkish leucogranite. It stands conspicuous on the northern brink of the depression leading down into a wide-crevassed glacial valley, which served as an effective barrier to wider exploration in the region, and was the scene of three accidents which nearly brought disaster to the field party. Because of its isolated position, some of the plant specimens were collected under sterile conditions for bacteriological investigation. In general, vegetation was very sparse as compared with other mountains just to the south, perhaps because of its recent emergence from the retreating ice cover.

Growing on coarse-grained leucogranite: common—*Usnea antarctica* and *U. frigida;* occasional—*Alectoria antarctica* and *Candelariella albovirens.* The mosses were *Grimmia Antarctici* and *Sarconeurum glaciale.*

Mt. Raymond Fosdick and the Volcano: 76° 34′ S.–144° 15′ W.—These peaks are included in the discussion principally because they were the most northerly mountains visited and were more nearly devoid of plant life than any other exposure. Climatic conditions could hardly account for sparseness of vegetation, for one of the most pronounced "blue ice lakes" borders the base of the volcano, which indicates melting temperatures. A medial moraine extends southward a mile from the volcano and is composed of basic lava with conspicuous inclusions of bright green olivine. The lava weathers easily and the moraine contains much fine, dusty material.

Rising above the volcano to the north is the main backbone of the Raymond Fosdick Mountains. It is composed of contorted gneisses formed when the volcano erupted on its southern side. The exposure was visited toward the close of a three-day blizzard which made searching for plant specimens difficult. Whether the peak was devoid of plant life one cannot be absolutely certain, but apparently it had no more vegetation than the volcano and moraine which were searched diligently under more favorable conditions.

In contrast to the lack of lichens and mosses was the abundance of microscopic life in a small pond of ice formed in the moraine at the foot of the mountain. The pink color of the ice attracted attention, and small samples were taken and later melted at Little America. Under the microscope red rotifers, water bears, infusoria, and algae began a vigorous rejuvenation of life. The original source of these organisms can only be guessed at.

The nearest bird life observed in this vicinity was at Skua Gull Peak and at Saunders Mt. nearly 40 miles "down wind," i. e., away from prevailing wind.

Several assumptions may explain lack of vegetation in the volcano vicinity: that mountain and moraine may have been too recently uncovered to have received a plant cover; that prevailing easterly winds would tend to bring less spores to the mountain because there are few nunataks to the east; that the black porous lava becomes quickly heated by the sun and evaporation follows too rapidly to support vegetation—in fact, the moraine was dusty dry; that some chemical in volcanic material may be unsuitable for plant growth; that the position of the range on the south side might permit less light, a condition similar to the south side of Saunders Mt., but in opposition to the luxuriant growth of Mt. Helen Washington; and lastly that air drainage may have been a factor, for heavy winds pour down the mountain, as evinced by orientation of snow drifts.

Queen Maud Mts.—The plant specimens obtained by the Queen Maud Geological Party were collected at two stations, incidental to geological investigation,[6] and there are few notes on distribution. The forms are unusually interesting because they are the most southerly plants thus far recorded in the world, and three, as mentioned before, were found within 237 nautical miles of the geographical South Pole. This is considerably farther poleward than land plants grow in the Arctic, due to lack of islands or nunataks in the Arctic Sea. The plants were growing in small crevices on granites and

[6] Blackburn, Quin A. The Thorne glacier section of the Queen Maud Mountains. Geog. Rev. 27: 598–614. *25 fig.* 1937.

schists, and were generally tiny forms rather easily detached. They grew also on chips of rock and sand. No mosses were found.

Three of the lichens are also found in the mountains of Marie Byrd Land and King Edward VII Land, two of them sterile. The rest are endemic. A species of *Hormiscium* parasitizes some thalli and appears the same as that to the north.

Durham Point (Durham Mt., N.E. portal of Thorne Glacier): approximately 85° 31′ S.–151° 20′ W.; elevation 1200 ft.—

Growing on fine-grained granite (deep olive buff), granitic sandy loam, dark brownish gray schist, and other schists: common—*Lecidea cancriformis* (also in King Edward VII Land) and *Protoblastenia citrinigricans;* occasional--*Alectoria antarctica, Buellia Russellii, B.* sp. (sterile), *Lecidea Blackburni, Lecanora fuscobrunnea,* and *Hormiscium* sp.

Scudder Mt.: 86° 03′ S.–150° 40′ W., between Organ Pipe Mts., Mt. Bruce Harkness and Mt. McKercher: (Pl. 36, fig. 4; pl. 37, fig. 2.—

Growing on granitic sandy loam, easily detached: common—*Lecidea Blackburnii, L. cancriformis, Protoblastenia citrinigricans;* occasional—*Lecidea Painei.*

From the factors governing growth of plants and their distribution upon different nunataks, a few generalities and observations suggest themselves. They are enumerated to aid readers who are interested in studying more closely the pattern of distribution of such plant species as are pioneers upon a glaciated land simultaneously with the retreat of the ice. It is difficult to explain what factors have made so many species endemic to this polar land without known affinities in warmer latitudes; but perhaps in warmer climates other plant forms crowd out polar flora, or the polar species may not be properly adaptable to conditions in warmer latitudes, customarily considered more ideal for plant growth. On the other hand, polar conditions may have forced the plants arriving from the outside world to adopt new forms with altered specific characteristics in order to exist under such rigorous and dry conditions. The following pages are a summary of the species and their general distribution characteristics.

Distribution and substrates	Plants	Number mts. where found	Remarks
Mosses extending into both Graham Land to the east and South Victoria Land to the west	*Sarconeurum glaciale* *Bryum antarcticum*	3 1	
Lichens extending only into South Victoria Land to the west, which lies in the path of prevailing easterly winds blowing from Marie Byrd Land	*Usnea antarctica* *Protoblastenia aurea?* *Buellia frigida* *Buellia flavoplana*	5 2 2 1	*Protoblastenia aurea* is doubtfully included here, as the material from South Victoria Land is sterile
Moss extending only into Graham Land to the east, from which prevailing easterly winds blow to Marie Byrd Land	*Grimmia Antarctici*	6	
Lichens widely distributed on both dark metamorphic sediments and on granitic mountains	*Alectoria antarctica*	11	Widest distribution of any species, from Queen Maud Mts. to almost all coastal mountains
	Usnea frigida	7	Most conspicuous species and probably most abundant; very hardy but sterile
	Candelariella albovirens	7	Wide distribution but not very numerous
	Catillaria floccosa *Protoblastenia flava*	6	Usually growing loose or easily detached where mosses were found
	Usnea antarctica	4	Much less abundant than *Usnea frigida*
	Buellia sp. (sterile)	4	Wide distribution including Queen Maud Mts., King Edward VII Land, and Marie Byrd Land, but not abundant
Lichens widely distributed between granitic and dark metamorphic sedimentary mountains	*Buellia muscicola* *Buellia dendritica*	4	Not abundant, distribution similar for both species.
	Polycauliona pulvinata	4	Not abundant and usually associated with *Parmelia* sp., upon which it seemed to be growing
	Umbilicaria rugosa	3	Abundant where found, seeming to require dark weathered rocks

Distribution and substrates	Plants	Number mts. where found	Remarks
Lichens widely distributed on both granitic rocks and dark metamorphic sedimentary rocks, apparently preferring the former	*Usnea antarctica*	5	Widely distributed on igneous mts. and on dark sedimentary mts. restricted to Skua Gull Peak
	Umbilicaria cerebriformis	3	Grows under conditions similar to *U. rugosa*
Lichens widely distributed on both granitic and dark metamorphic sedimentary rocks, apparently preferring the latter. On only one granite mountain	*Buellia stellata*	5	Only on an igneous erratic at Mt. Stancliff
	Buellia grisea *Lecidea capsulata*	5 4	Commonly on sericite schist
Lichens on peaks of different material 40–50 miles apart; none abundant	*Lecidea Coreyi* *Lecidea Stancliffi*	2	On Mt. Grace McKinley and Lichen Peak
	Lecidea Wadei	2	On Mt. Rea-Cooper and Garland Hershey Ridge
Moss and lichens growing on different rock structure but localized on neighboring moun tains	*Catillaria floccosa* *Parmelia variolosa* *Blastenia succinea*	3	On Mt. Rea-Cooper, Lichen Peak, and Skua Gull Peak
	Candelariella chrysea	2	Loose or easily detached on Chester Mts. and Lichen Peak
	Buellia frigida *Parmelia leucoblephara*	2 3	Same peaks as above but on rocks, the last species also on Mt. Donald Woodward
	Grimmia Antarctici var. *pilifera*	2	On Mt. Rea-Cooper and Mt. Donald Woodward
	Buellia Siplei	2	Loose or easily detached on Mt. Rea-Cooper and Lichen Peak
	Buellia chrysea	2	On rocks, Mt. Rea-Cooper and Lichen Peak
	Buellia pallida	2	On rocks, Mt. Rea-Cooper and Haines Mts.
Moss and lichens growing on or near mountains wher bird life is present; correlation uncertain	*Buellia olivaceobrunnea* *Umbilicaria pateriformis* *Protoblastenia aurea* *Bryum Siplei*	3 2 2 2	. On Mt. Helen Washington and Skua Gull Peak; first species also on Mt. Stancliff

Distribution and substrates	Plants	Number mts. where found	Remarks
Lichens growing only on igneous rocks	*Lecidea cancriformis*	2	Wide distribution, on Mt. Helen Washington and Queen Maud Mts.
	Rinodina olivaceobrunnea	2	On moss clumps or sandy loose material at Mt. Rea-Cooper and Mt. Helen Washington
	Catillaria inconspicua	2	On rocks in restricted locality on Mt. Rea-Cooper and Chester Mts.
Moss and lichens only on dark metamorphic sedimentary mountains (schists and slates); widely distributed	*Lecidea Siplei* *Pyrenodesmia Darbishirei* (sterile)	4	Both species growing loose or easily detached on mountains where mosses are common
	Lecanora griseomarginata *Barbula Byrdii*	3	Wide distribution, growing loose or easily detached
	Gasparrinia Siplei *Rhizocarpon flavum*	3	Restricted distribution but abundant; commonly on rock
Lichens widely distributed on two dark sedimentary mountains	*Thelidium Caloplacae* *Kuttlingeria rutilans*	2	On Mt. Donald Woodward and Skua Gull Peak
	Thelidium inaequale	2	On sericite schist, Mt. Donald Woodward and Lichen Peak
	Buellia alboradians	2	On sericite schist, Lichen Peak, and Haines Mts.
	Buellia floccosa	2	On sericite schist, Haines Mts., and Mt. Stancliff
Lichens with limited distribution on two or more dark metamorphic sedimentary mountains	*Buellia albida*	3	On sericite schist, Mt. Stancliff, Lichen Peak, and Skua Gull Peak
	Catillaria cremea *Parmelia Coreyi* *Umbilicaria spongiosa*	2	On Lichen and Skua Gull Peaks. The second is more abundant, the last is the largest species
	Huea flava	2	On rocks, Lichen Peak and Mt. Stancliff
	Sarcogyne grisea	2	On rocks, Lichen Peak and Mt. Stancliff, at latter on erratic igneous rock
Lichens growing on igneous schists and endemic to Queen Maud Mts.	*Lecidea Blackburni* *Lecidea Painei* *Protoblastenia citrinigricans* *Lecanora fuscobrunnea* *Buellia Russellii*	1	Growing nearest the South Pole, collected by the Queen Maud Geological Party

Distribution and substrates	Plants	Number mts. where found	Remarks
Moss and lichens growing only on a single igneous mountain	*Buellia brunnescens* *Buellia dendritica* *Lecidea ecorticata* *Lecidea Byrdii* *Catillaria arachnoidea* *Lecanora subolivacea*	1	Growing on coarse-grained leucogranite, Mt. Rea-Cooper; usually on small rocks in small trickles of water. First three species very common
	Grimmia Antarctici var. *percompacta* *Catillaria granulosa* *Umbilicaria cristata*	1	On coarse-grained leucogranite, Mt. Helen Washington
	Sarcogyne angulosa	1	On quartzite, Chester Mts.
Lichens growing sparsely on a single mountain of dark metamorphic sedimentary rocks	*Biatorella arachnoidea* *Lecanora carbonacea*	1	On dike rocks at Skua Gull Peak
	Rinodina sordida *Polycauliona sparsa*	1	On sericite schist, Skua Gull Peak
	Umbilicaria spongiosa *Parmelia griseola*	1	On rocks at Skua Gull Peak, but easily detached
	Blastenia grisea *Pannoparmelia pellucida* *Pannoparmelia delicata*	1	On sericite schist, Lichen Peak
	Lecanora lilacinofusca *Lecanora lilacina*	1	Loose or easily detached, Lichen Peak; mosses common
	Kuttlingeria rufa *Buellia flavoplana* *Protoblastenia alba*	1	On sericite schist, Mt. Donald Woodward

SUMMARY

From thousands of plant colonies reviewed in the field and hundreds brought back to the laboratory for identification, at least 89 species of lichens and 5 of mosses are determined. The lichens were collected from some 215 distinct localities on 12 mountains, and represent not only a random cross-section through Marie Byrd Land and King Edward VII Land, but rather diverse conditions as well. On 8 of the 12 mountains there were relatively few mosses. Where they were most abundant, lichen forms were also most numerous.

Of the two dominant rock types in the region, dark metamorphic sedimentary rocks and the loftier igneous rocks, based

on observations made in northwestern Marie Byrd Land, two-thirds of the plant species were found on the former type, probably because snow melts faster on dark rocks than on light-colored granitic rocks. Mt. Stancliff, with its accompanying Skua Gull Peak, surrounded by larger mountains on all sides, lies within the central zone of mountain exposures and represents a focus of abundance in plant growth. The warming effect of lower latitude is obvious, but more important are the factors of available moisture and shelter from wind.

Mt. Helen Washington, with its snowy petrel rookery (pl. 33, fig. 5), exhibits remarkable abundance of plants, but the number of species is little more than half that of Skua Gull Peak where birds are fewer. Even Mt. Rea-Cooper and Lichen Peak, devoid of bird life, have more species than Mt. Helen Washington, a response perhaps to shelter from wind or to a warmer latitude of one degree farther north. While Mt. Helen Washington lies to the south of the elevated mass of King Edward VII Land, the former is more exposed to the north.

The fact that all species of mosses and lichens in the collection are endemic to the Antarctic, if not to the locality, brings the question of origin strongly to the foreground. Several different conclusions might be suggested, but the writer feels that no definite proof is possible in the light of meager data from other sections of Antarctica and adjacent land masses.

First, it might be conjectured that plant spores have existed in crevices of rock, imprisoned in ice or suspended in upper atmosphere, and represent an ancient flora of Antarctica before the ice age, which has once more found a foothold on the denuded peaks. However, lack of endemic genera casts immediate doubt upon such a conclusion.

If then, as an alternative, it is concluded that plant spores have been transported to the continent from land masses to the north, distribution within the continent demands explanation. If spores are so widely distributed within Antarctica, why should not some of the forms escape or more common forms enter? Answers to this question lie in the fact that perhaps still too little is known about alpine lichens of the Andes, Australia, New Zealand, and of the intermediate islands. It is

possible that common species entering the Antarctic must make such rapid adjustments to new conditions that the speed of evolutionary processes to form new species is hastened as plants adapt themselves to the rigor and dryness of the new climate.

Wind has probably been the most instrumental means of distributing plant spores, and to a lesser extent redistributing locally broken vegetative parts from peak to peak. Ice and water have had an active but more limited part in the processes. Detailed study may possibly prove to what extent birds help in disseminating spores. It must be kept in mind that snowy petrel, McCormick skua gull, and Antarctic petrel are natives of Antarctica and have a range that in general does not extend much beyond the northern limit of the pack ice, although occasionally the birds pass the 50th parallel. If they have aided in distributing spores and plant parts, it may have been through island bridges, or, as is more likely, they have been of greater aid in redistributing plant life after it entered the continent than in actually helping to introduce it.

The writer concludes that the most important part played by birds is enrichment of rock exposures with guano. It is apparent that two of the mountains exhibiting the greatest wealth in quantity of plants were those which had visiting bird life. On the other hand, many surrounding mountains, almost as luxuriant in growth, have species not represented on mountains visited by birds. Climatic and shelter conditions which made mountains desirable for birds were also conditions conducive to optimum plant growth within the region. If the bird-frequented mountains, i. e., Skua Gull Peak and Mt. Helen Washington, had representatives of all of the species found elsewhere, the argument for bird distribution of spores would be very strong, but such was not the case. In further support of bird activities, it should be recalled that every inland party going toward Queen Maud Mts. has reported the appearance of occasional skua gulls, which may take solitary flights directly across the continent. However, only three of the Queen Maud species found by the Byrd expedition had affinities with coastal species.

The collection made by the Marie Byrd Land party represents, no doubt, the majority of the larger and more conspicuous species, but as may be seen from the data, most of the mountains had species apparently restricted to them. Of mountain exposures where plant life probably exists, less than 10 per cent of the area has been visited. No doubt more than twice as many species prevail as have been found; and if the regions could be charted much more information concerning the distribution factors of the plants lying on the poleward margin of plant growth would be available.

There is need for more collecting. Even in the regions which have been visited most frequently, it is likely that only a few of the lichen species have been brought back for identification. Most observers not especially interested in plant life would overlook all but the most obvious plants, for the majority of the lichens appear as little more than crumbs of dirt on rocks. Keen search for plant growth will be necessary in the future for more complete collections from the continent. Specimens from the coasts bordering the Indian Ocean and from the mountains discovered recently by Lincoln Ellsworth east of Marie Byrd Land will be especially valuable.

The British Graham Land Expedition led by Rymill, which returned in 1937, has made a collection of plants which, when identified, will throw more light upon plants to the west of Graham Land.

In the light of observations made within Marie Byrd Land it seems probable that the plant species of Antarctica are much more numerous on the continent proper than the one or two hundred known species thus far collected would indicate.

Acknowledgment is due Commander H. E. Saunders for the map (page 475) of King Edward VII Land and northwestern Marie Byrd Land, which was drawn from the reconnaissance map now in preparation by him. The map was constructed from aerial photographs and ground-control survey made by the Marie Byrd Land Sledging Party, the route of which is shown. Shaded portions are conjectured edges of the land mass and should not be considered definite.

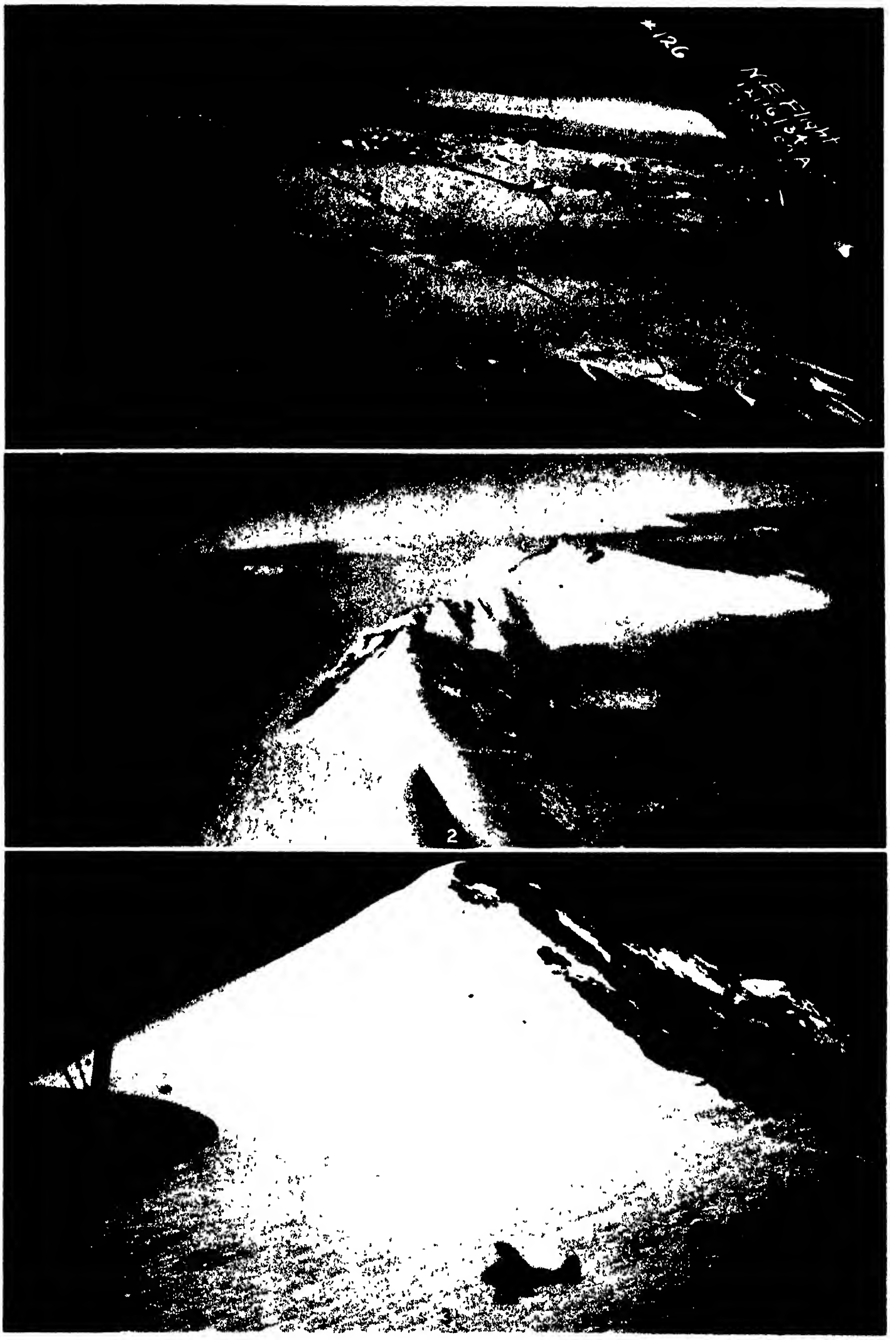
Explanation of Plate

PLATE 32

Fig. 1. General view of Edsel Ford Ranges of northwestern Marie Byrd Land as seen in an aerial photograph taken above northeastern exposures of Haines Mts., showing route of Sledging Party.

Fig. 2. Mt. Helen Washington lying on the southern side of King Edward VII Land, as seen from the air. A rookery of snowy petrel was found on the peak in the foreground, and all plant specimens were taken from this area.

Fig. 3. Mt. Helen Washington. A closer view of the southernmost peak on which the snowy petrel rookery was found. A line of lower limit of plant growth is visible. Lack of growth below this line is probably due to recent recession of ice, and concentrated plant growth just above it is probably due to the greater supply of moisture trickling down the mountain side.



SECOND BYRD ANTARCTIC EXPEDITION

Explanation of Plate

PLATE 33

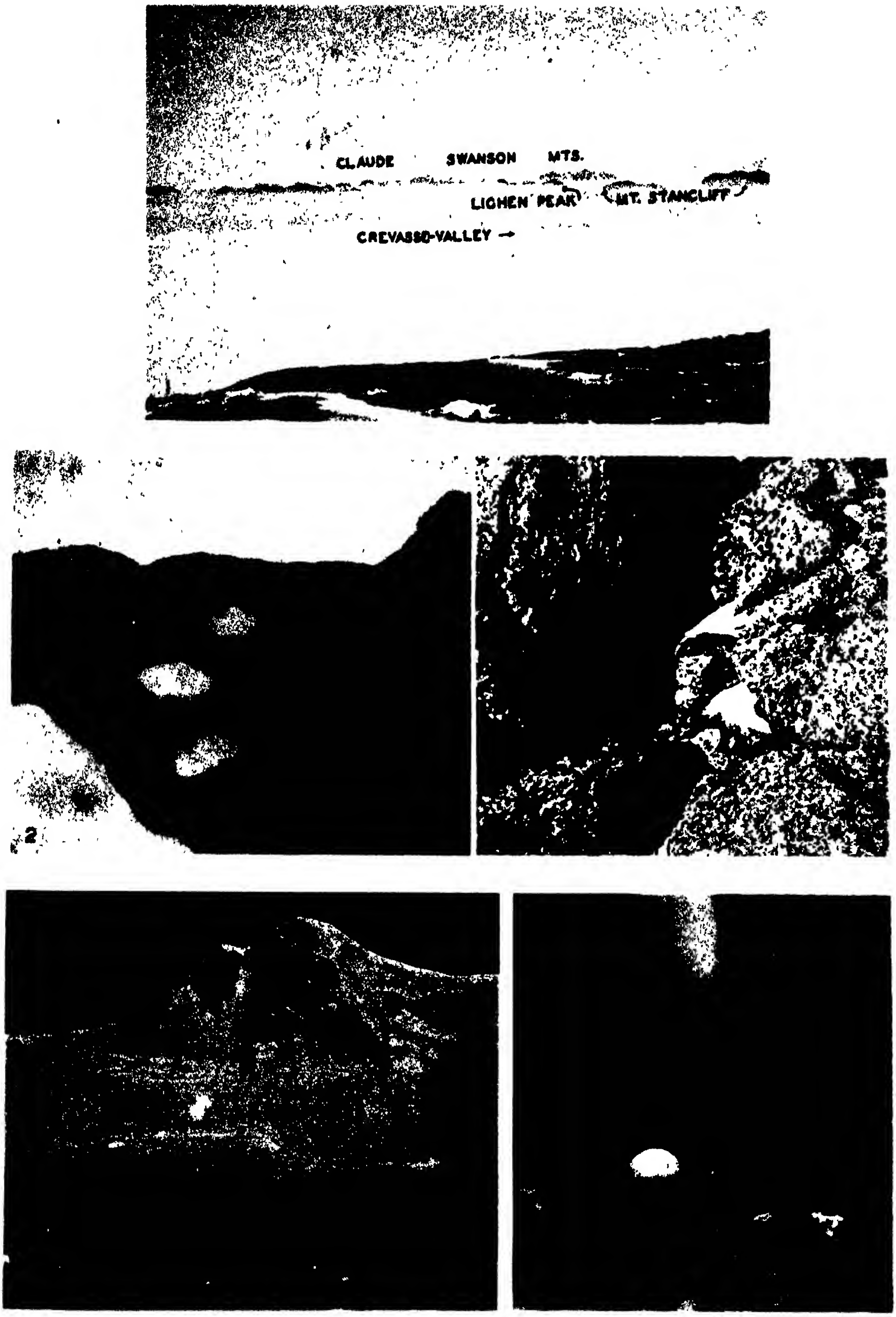
Fig. 1. Claude Swanson Mts. A view of numerous peaks lying 25 miles south of Chester Mts., of which only the two most northern ones have been visited.

Fig. 2. Mt. Grace McKinley. Strange depressions probably formed by wind erosion in weak portions of coarse-grained leucogranite are catchment basins for snow which melts to form a water supply for *Alectoria antarctica.*

Fig. 3. Mt. Rea-Cooper. Plant life decorates rocks as raisins in a pudding. Slow melting of snow in such depressions is a water supply during growing periods.

Fig. 4. Haines Mts. A northeastern exposure showing location of outcrops too perilous for collecting specimens.

Fig. 5. Mt. Helen Washington. A snowy petrel egg lying in sheltered retreat between rocks. Guano enriches the growth of lichens which may be seen on weathered coarse-grained granite. (Photo of O. D. Stancliff.)



SECOND BYRD ANTARCTIC EXPEDITION

EXPLANATION OF PLATE

PLATE 34

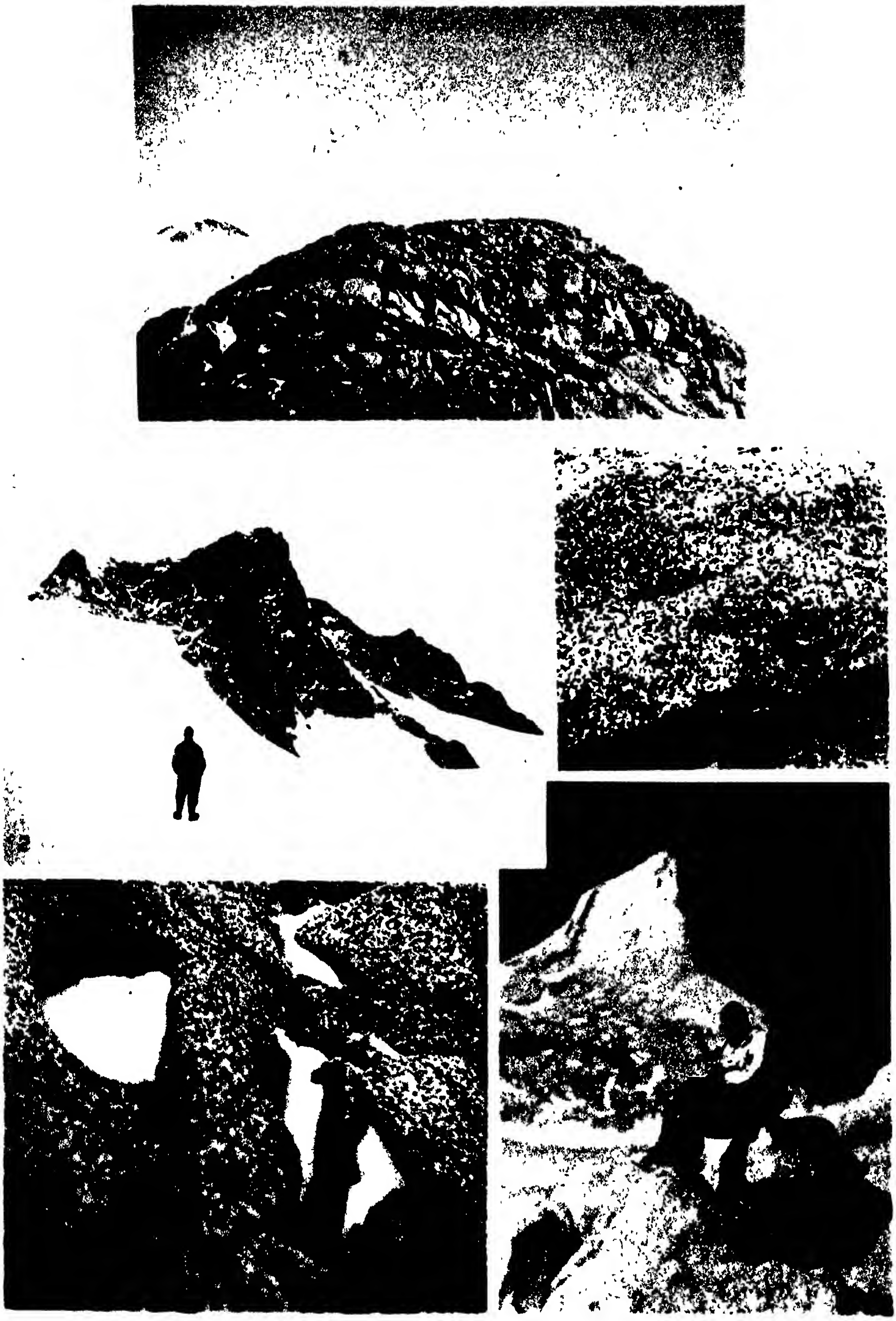
Fig. 1. Mt. Rea-Cooper. View facing southwest, with Mt. Donald Woodward to the left and Haines Mts. in central distance. In foreground is a knob of igneous rock with stoped inclusions of schists of sedimentary origin.

Fig. 2. Mt. Grace McKinley. View taken about a mile to the northeast. North face of mountain is sheer cliff, while south slope is more gentle and snow covered. Only approachable area for collection is along precarious upper edge of cliff.

Fig. 3. Mt. Grace McKinley. Small isolated patches of *Usnea* and *Alectoria* growing on coarse leucogranite.

Fig. 4. Mt. Grace McKinley. Small structural hollows form catchment basins for snow which melts slowly and forms the water supply for plant growth. Plants are mostly *Alectoria*.

Fig. 5. Mt. Rea-Cooper. F. Alton Wade, geologist, sitting on one of the boulders of the talus slope on the west side of Mt. Cooper. Note small isolated patches of plant life on the rocks, a common characteristic. Such plants receive little moisture and are seldom large. (Photo of O. D. Stancliff.)



SECOND BYRD ANTARCTIC EXPEDITION

Explanation of Plate

PLATE 35

Fig. 1. Mt. Stancliff, seen looking southwest from Chester Mts. Mt. Stancliff is encircled by other mountains and enjoys the richest flora, amounting to nearly 50 species of lichens and mosses.

Fig. 2. Skua Gull Peak, with the loftier parts of Mt. Stancliff rising in the background to the east. The pond nestled in the top of this peak remains unfrozen during the summer and is abundant in microscopic life. Skua gulls visit it periodically, probably as a resting place. Mosses and lichens are abundant all about this sheltered pond. Note the growths on the rock in the foreground.

Fig. 3. Mt. Rea-Cooper. Talus slope which supports most of the plant life found on this mountain. About two miles away is the sheerest cliff of Mt. Rea, nicknamed "Billboard" because of its appearance.

Fig. 4. Skua Gull Peak. A crest view showing a drier area almost free of snow in early summer. Plant life here becomes sparser due to lack of available moisture, but is common in cracks. The flat spreading *Lecanora* may be seen on the vertical faces in the left foreground.

SECOND BYRD ANTARCTIC EXPEDITION

Explanation of Plate

PLATE 36

Fig. 1. Mt. Rea-Cooper. General aspect of the sheer cliffs at the northern end of Mt. Cooper, several of which were nearly 1000 ft. high. Morainic material and talus were best collecting grounds. This picture was taken nearly a mile to the west of the mountain. Note the stoped blocks of shists in the granite rock mass. (Photo of O. D. Stancliff.)

Fig. 2. Skua Gull Peak. An area of typical abundant growth of plants on dark metamorphic sediments. Note the flat sloping rock surface which permits a trickle of water from snow above, also the accumulation of plant growth in cracks and hollows. The broad patch in the center toward which the forcep handle is pointing is the conspicuous red branching *Gasparrinia Siplei.*

Fig. 3. Mt. Rea-Cooper. General appearance of lichen growths grouped together on coarse leucogranite. Note the plants on the small rocks. As many as ten species were found on a single stone. (Photo of O. D. Stancliff.)

Fig. 4. Scudder Mt. near Organ Pipes, Queen Maud Range. Most southerly plant life so far collected, 237 nautical miles from the South Pole. (Photo of R. S. Russell, Jr.)

Fig. 5. Mt. Donald Woodward. An encampment of the Marie Byrd Land Sledging Party about a quarter of a mile from the mountain. A wind moat lies between camp and base of the mountain. Note the blackness of metamorphic sedimentary schists.

4

2

SECOND BYRD ANTARCTIC EXPEDITION

Explanation of Plate

PLATE 37

Fig. 1. Mt. Corey, looking north toward volcano and Raymond Fosdick Mts. Dark rocks to left are remnants of the cone, and higher peaks in background are granites and gneisses. No plants found at that point. In the foreground is an ice-polished dome of Mt. Corey which supports sparse vegetation.

Fig. 2. Queen Maud Mts. View of Organ Pipes as seen from Scudder Mt. where most southerly lichens were collected. In front, Richard S. Russell, Jr., one of the members of Queen Maud Geological Party.

Fig. 3. Mt. Rea. Moss clumps and lichens grouped along a miniature drainage line.

Fig. 4. Mt. Donald Woodward. Appearance of north face of mountain from about a mile away.

Fig. 5. Chester Mts. Typical rocky surface which supported moderate growths of mosses and lichens. This is southeast exposure with Raymond Fosdick Mts. to northeast.

2

II. Lichens and Lichen Parasites

CARROLL W. DODGE
Mycologist to the Missouri Botanical Garden
Professor in the Henry Shaw School of Botany of Washington University

AND GLADYS E. BAKER
Instructor in Botany, Hunter College
Formerly Research Assistant, Henry Shaw School of Botany of Washington University

Through the kindness of Mr. Paul A. Siple, Biologist of the Second Byrd Antarctic Expedition, we have had an opportunity to study his large and interesting collection of the lichens and lichen parasites from Marie Byrd Land and King Edward VII Land and a small but representative collection by the geological party from the Queen Maud Mountains of South Victoria Land. The most complete set of plants has been deposited in the herbarium of the Missouri Botanical Garden and duplicates distributed to the larger herbaria. We also wish to express our appreciation to Professor N. Svedelius of the Botaniska Institution, Upsala, and to Professors Jens Holmboe and Bernt Lynge of the Botaniska Museet, Oslo, for the loan of material of the Borchgrevink Expedition to South Victoria Land for comparison with our material; also to Professors R. B. Wylie and G. W. Martin, who placed the facilities of the botany department of the University of Iowa at the disposal of the junior author for a portion of the work; and finally we are grateful to the Science Research Fund of Washington University for financial assistance in this study. The junior author also desires to make special acknowledgment of her indebtedness to the late Professor R. P. Baker of the University of Iowa, both for the initial suggestion to study this collection and the inspiration of his enthusiasm for all scientific advance.

Studies of the Antarctic flora are usually limited to plants occurring south of 60° rather than of the Antarctic Circle, in order to include the groups of islands commonly known as the Antarctic or Graham Land Archipelago. This somewhat

Issued May 6, 1938.

arbitrary limit excludes South Georgia and the South Sandwich groups, whose floras are intermediate between Tierra del Fuego and the Falkland Islands to the north and the Graham Land Archipelago to the south. It also excludes Macquarie Island, the southernmost of the islands between New Zealand and South Victoria Land, and Kerguelen Land which is nearest to Kaiser Wilhelm II Land.

After the collections of Joseph Dalton Hooker, on the voyage of the Erebus and Terror (1839–1843) from Cockburn Island in the Graham Land Archipelago, little information was available until the beginning of the twentieth century. Since then our knowledge has increased very rapidly, as may be seen in the accompanying table. The number of species given is only approximate, as it is very difficult to evaluate the synonymy from lists of species without descriptions of the Antarctic plants. For some of the expeditions we may have overlooked publication of the results or specimens may not have been secured, but the table does give a rough comparison of results.

TECHNIQUE

With few exceptions most of the specimens were brought back from Antarctica in a dried condition. The larger ones were placed in a moist chamber and thoroughly softened before they were killed in formol-acetic-alcohol. Small saxicolous species were moistened *in situ* with a drop of 95 per cent alcohol followed by a drop of water, then placed in the killing solution. Specimens fixed at the time of collection were preserved in 4 per cent formalin or 70 per cent alcohol. Following fixation all material was dehydrated by a butyl alcohol series according to Zirkle ('30). Usually the material was allowed to remain in the paraffin oven about 72 hours previous to imbedding. After imbedding, the blocks were trimmed and left to soak in water for 48 hours, then sectioned. Lichens, usually thought to be difficult to cut in paraffin, are easily handled with such treatment and give good results. Serial sections were cut at thicknesses of 15, 10 and 5 μ, 10 μ apparently being most satisfactory. Practically all the slides were stained with Haiden-

SUMMARY OF ANTARCTIC COLLECTIONS

Dates	Leader	Ships	Collector	Author Bot. Rept.	Herb.	Total sp.	New to Antarctic	New sp.	Region Explored
1839–43	Ross	Erebus Terror	Hooker f.	Hooker f. '45 Hooker & Taylor '44	Kew Boston	9	9	3	Cockburn I. Graham Land
1897–99	Gerlache de Gommery	Belgica	Racovitsa	Vainio '03	Turku	55	51	29	Graham Land
1898–00	Borchgrevink	Southern Cross	Hanson, et al.	Fries '02 Blackman '02	Oslo	4 4	3 1	1 0	S. Victoria Land
1901–03	Drygalski	Gauss		Zahlbruckner '06		3	0	0	K. Wilhelm II Land
1901–03	Nordenskjöld	Antarctic	Skottsberg	Darbishire '12	Stockholm	47	19	9	Graham Land
1901–04	Scott	Discovery		Darbishire '10	Brit. Mus.	24	12	5	S. Victoria Land
1902–04	Bruce	Scotia	Rudmose-Brown	Darbishire '05		11	6	0	Graham Land
1903–05	Charcot	Français	Charcot Turquet	Hue '08	Paris	16	6	4	Graham Land
1907–09	Shackleton	Nimrod	Priestley	Darbishire '23	Brit. Mus.	15	1	1	S. Victoria Land
1908–10	Charcot	Pourquoi Pas	Gain Liouville	Hue '15	Paris	112	93	89	Graham Land
1910–11	Amundsen	Fram	Prestrud	Unpublished	Oslo	..	..	..	S. Victoria Land
1910–11	Scott	Terra Nova		Darbishire '23	Brit. Mus.	17	8	8	S. Victoria Land
1911–14	Mawson	Aurora		Cheel	Adelaide				S. Victoria Land
1914–16	Shackleton	Endurance		Darbishire '23	Brit. Mus.				Weddell Sea
1928–30	Byrd	E. Bolling City of N. Y.	Gould?		U. Mich.?				K. Edward VII Land S. Victoria Land
1933–35	Byrd	J. Ruppert Bear of Oakland	Siple Blackburn	Dodge & Baker '38	Mo. Bot. Gard.	89	84	84	Marie Byrd Land K. Edward VII Land S. Victoria Land

hain's iron-alum haematoxylin with a counter stain of phloxine (a 1 per cent solution in 95 per cent alcohol). Such slides served as the basis of the morphological studies.

For the series showing the ascus development from young to mature stages, small apothecia or portions of larger apothecia were moistened with a weak solution of potassium hydroxide, washed in water, and mounted in lacto-phenol to which was added 10–20 drops of 1 per cent acid fuchsin and 1 drop of cotton blue according to Maneval ('36). The mounts were crushed slightly to spread out the thecial elements. Nuclei often show clearly after such treatment, but all nuclear details illustrated were either taken from or substantiated by similar details found in the permanent slides. All habit sketches were drawn with the aid of a binocular dissecting microscope at suitable magnifications. An Abbé camera lucida was used for all other drawings.

Measurements expressed in millimeters were made by means of a micrometer disc inserted in the 17× ocular of a binocular dissection microscope calibrated for the various objectives. Measurements expressed in microns were based on a range of sizes secured from both whole mounts and permanent slides. In many instances, scarcity of material prevented more than a single sample of each mount, thereby limiting ranges to two or even one apothecium. Additional collections therefore might easily modify the sizes as here recorded. Figures given in parentheses indicate a single exception. Measurements for the algae are for single cells unless a colony is specified.

Measurements of the ascus were taken from the longest and broadest points of each. In illustrating the developmental series the youngest stage observed, the stage at which the gelified sheath appears, a stage of the developing spores, and the mature ascus were usually figured. All asci and spores were drawn at a common magnification. Throughout the material, the asci show a protective gelified sheath varying from thick to thin as shown by pl. 44, fig. 99; pl. 46, fig. 136; pl. 53, figs. 262, 267. Such a sheath apparently is not of rare occurrence in lichens of the temperate regions but seems to be rarely recorded (cf. Nannfeldt, '32, p. 68). It appears to be

somewhat thicker than those we have observed from the temperate zone. Although the ascus is a stable organ, a comparison of forms makes it clear that more than agreement of overall dimensions is necessary to establish the identity of asci. Ascospore sizes are given for the largest to the smallest noted.

MORPHOLOGY

The structural diagrams are figured on too small a scale to show individual cells, and consequently the types of tissue composing cortex and medulla are diagrammatic and standardized. Such figures are augmented by details of distinctive tissues on an enlarged scale. The terminology has been based on that of Hue as given in Smith ('21).

CORTEX

Intricate, not clearly represented in our species.

Fastigiate, e. g. in *Lecanora Siplei* (pl. 47, fig. 151) and *Buellia floccosa* (pl. 57, fig. 334).

Decomposed, not common but found in *Protoblastenia aurea* (pl. 52, fig. 230).

Pseudoparenchymatous (plectenchymatous), the most common type of cortex in these lichens, varying from a very compact tissue to occasional scattered cells, the latter usually large and fuscous, e. g. *Lecidea cancriformis* (pl. 41, fig. 48) and *Polycauliona sparsa* (pl. 54, fig. 281) for the compact types, and *Umbilicaria rugosa* (pl. 44, fig. 104) and *Buellia alboradians* (pl. 56, fig. 322) for the loose, scattered types.

Fibrous, most commonly found in the lower cortex as in *Parmelia Coreyi* (pl. 50, fig. 202) and *P. griseola* (pl. 50, fig. 206) but sometimes found in the upper cortex as in *Lecidea Siplei* (pl. 39, fig. 25).

MEDULLA

Felted, the most frequent type ranging from very loose and arachnoid to more or less reticulate networks, e. g. *Candelariella albovirens* (pl. 49, fig. 180a) and *Protoblastenia flava* (pl. 52, fig. 228).

Cretaceous or tartareous, not found in our species.

Cellular, e. g. *Candelariella chrysea* (pl. 49, fig. 182).

Lower Cortex

Repetition of the upper cortex, common when a continuous cortex is present.

Close parallel hyphae, rare, sometimes fibrous as in *Parmelia* sect. *Physcioideae* (pl. 50, figs. 202 and 206) or vertical as in *Buellia dendritica* (pl. 59, fig. 362).

Completely lacking, the usual case in crustose lichens, e. g. *Lecidea capsulata* (pl. 38, fig. 12b), *Sarcogyne grisea* (pl. 46, fig. 133), and *Buellia flavoplana* (pl. 55, fig. 297).

Only Chlorophyceae have been found as symbionts, although the Myxophyceae are represented as free-living algae growing in patches on rocks and thalli of lichens and as endogenous cephalodia in a few species. Two species of Collemaceae have been reported from Antarctica: a very depauperate *Collema crispum?* by Hooker from Cockburn Island, and *Leptogium puberulum* by Hue from King George Island in the South Shetlands. In the austral family Stictaceae where species with blue-green symbionts are abundant in Tierra del Fuego and the Falkland Islands, only *Sticta endochrysea* (with protococcoid symbiont) has been found at Cape van Beneden, Danco Land, 64°41′ S. As Forssell ('85) and Hue ('11) have pointed out, the lichens with protococcoid symbionts seem to be a much older group. Hence it is possible that we are dealing with a very ancient flora which has survived in the Antarctic and that the more recent groups with blue-green symbionts have not been able to penetrate. In Marie Byrd Land and probably in South Victoria Land, the species have been isolated so long that endemic species have developed but few new genera. In the Arctic, the Collemaceae reach northern latitudes corresponding to the southern latitude of Marie Byrd Land and are abundant in genera and species even in East Greenland where environmental conditions seem to be similar to those of Graham Land and Marie Byrd Land.

Usually the algal symbiont is much less abundant than in species of the same genera from more temperate climates. In many species the algal cells are more or less scattered throughout the medulla rather than organized in a definite layer below

the cortex, as is the case with temperate species in the same genera. In some cases the assimilative portion of the thallus is confined to the cracks between the crystals and scarcely reaches the outer surface of the rock. In the *Buelliaceae,* the differentiation of the thallus into assimilative areoles and non-assimilative portion (referred to as hypothallus or prothallus by some authors) has been carried to extremes. The apothecia are often borne on the non-assimilative portion which is connected by long strands to the assimilative areolae.

The whole thallus in proportion to the apothecia is greatly reduced, compared with that of temperate species in the same genus. In foliose genera *Umbilicaria* is reduced to small, often densely folded rosettes in all but the most sheltered positions. *Parmelia* is reduced to small umbilicarioid *(P. (Omphalodium) quarta* Darb.) or physcioid thalli adnate to rocks or growing among dense tufts of mosses, evidently as a reaction to high wind velocities. *Pannoparmelia* suggests a very depauperate *Pannaria.* Even fruticose genera have much shorter and more delicate thalli. *Alectoria antarctica* is prostrate and more or less appressed to the substrate, becoming more erect in sheltered places but at most is only a few millimeters tall. *Usnea* reaches only a few centimeters, as compared with several meters in the cooler portions of the temperate zone.

Asexual reproduction by fragmentation is rather rare. Isidia occur in *Candelariella chrysea.* Only *Parmelia variolosa* and *Usnea* are sorediate, and even in these the small powdery patches look suspiciously like attempts at regeneration following injury by mites or other arthropods. A few bulbils were noted. Spermogonia have been rarely seen, in contrast to the large number reported by Hue from Graham Land Archipelago. Very few species lacked apothecia.

Imperfect fungi, while limited in species, are common. Often large groups of fruiting lichens and mosses were well covered, apparently parasitized. Rocks and pebbles often showed abundant hyphal patches. Even the smallest pebbles only 2–3 mm. in diameter were at times covered by fungous hyphae. *Hormiscium* sp. was usually the fungus thus observed (pl. 62,

fig. 407). In several cases, prepared slides revealed extensive patches of bacteria limited to the basal regions of the lichen among the material of the substrate (pl. 39, fig. 18). While no attempts have been made to cultivate these bacteria, we are reminded of the interesting observations of Cengia-Sambo ('23, '26), in which the nitrogen-fixing *Azotobacter* was reported growing with *Nostoc* in the thalli of various species of *Collema*. Sometimes the large dark areas covering mosses proved to be species of *Nostoc, Rivularia,* and *Scytonema.*

A dead skua gull, placed in a box in Antarctica, was considered to be relatively free from secondary infection, since it was unopened until it reached this laboratory. Portions of the bird, partially decomposed, were placed in sterile moist chambers at room temperature and at 9–10° C. in the refrigerator in an effort to determine what fungi were present. *Scopulariopsis brevicaulis* (Sacc.) Bain., a common organism in fingernails and other substances containing keratin, developed abundantly in all cultures (pl. 62, figs., 404, 405). Species of *Botrytis* (pl. 62, fig. 406) and *Penicillium* also developed abundantly.

BIBLIOGRAPHY

Blackman, V. H. 1902. Lichenes. Report on the collections of natural history made in the Antarctic regions during the voyage of the Southern Cross, 1898–1900. p. 320. London.

Cengia-Sambo, M. 1923. Polysimbiosi nei licheni a cianoficee e significato biologico dei cefalodi. Note di biochimica dei licheni. Atti Soc. Ital. Sci. Nat. Mus. Civico Stor. Nat. Milano **62**: 226–238.

——————, 1926. Ancora della polisimbiosi nei licheni ad alghe cianoficee i batteri sinbionti. *Ibid.* **64**: 191–195.

Darbishire, O. V. 1905. The lichens of the South Orkneys. Trans. & Proc. Bot. Soc. Edinburgh **23**: 105–111. *pl. 3.*

——————, 1910. Lichenes. National Antarctic Expedition. Natural History **5**: 1–11. *pl. 1.*

——————, 1912. The lichens of the Swedish Antarctic Expedition. Wiss. Ergebn. Schwed. Südpolar-Expedition, 1901–1903. **4**[11]: 1–74. *2 pl.*

——————, 1923. Lichens. British Antarctic ("Terra Nova") Expedition, 1910. Nat. Hist. Rept. Bot. 29–76. *2 pl.*

——————, 1923. Cryptogams from the Antarctic. Jour. Bot. Brit. & For. **61**: 105–107. *2 fig.*

Forssell, K. B. J. 1885. Anatomie und Systematik der Gloeolichenen. Nova Acta R. Soc. Sci. Upsal. III. **13**: 1–118.

Fries, Th. M. 1902. Lichenes antarctici. Nyt Mag. Naturvidensk. **40**: 208–209.

Hooker, J. D. 1845. The cryptogamic botany of the Antarctic voyage of H. M. discovery ships Erebus and Terror in the years 1839–1843, under the command of. . . . James Clark Ross. I–IV. 1–258. *pl. 1–198.* (Lichens, pp. 213–236.)

Hooker, J. D. and T. Taylor. 1844. Lichenes Antarctici; being characters and brief descriptions of the new lichens discovered in the southern circumpolar regions, Van Diemen's Land and New Zealand during the voyage of H. M. discovery ships Erebus and Terror. London Jour. Bot. [Hooker]**3**: 634–658.

Hue, A. M. 1908. Lichens. Expédition Antarctique Française (1903–1905) commandée par le Dr. Jean Charcot. 1–17. Paris.

————, 1911. Monographiam generis Solorinae Ach. morphologice et anatomice addito de genere Psoromaria Nyl. appendice. Mém. Soc. Nat. Sci. Nat. Math. Cherbourg **38**: 1–56.

————, 1915. Lichens. Deuxième Expédition Antarctique Française (1908–1910) commandée par le Dr. Jean Charcot. 1–202. *1 map.* Paris.

Maneval, W. E. 1936. Lactophenol preparations. Stain Technol. **11**: 9–11.

Nannfeldt, J. A. 1932. Studien über die Morphologie und Systematik der nichtlichenisierten inoperculaten Discomyceten. Nova Acta R. Soc. Sci. Upsal. IV. **8**[2]: 1–368. *pl. 1–20.*

Smith, A. L. 1921. Lichens. i–xxviii, 1–464. *135 fig.* University Press, Cambridge. [cf. pp. 82–91.]

Vainio, E. A. 1903. Lichens. Résultats du voyage du S. Y. Belgica en 1897–1899. Expédition Antarctique Belge, Anvers. 1–46. *pl. 1–4.*

* Zahlbruckner, A. 1906. Die Flechten der Deutschen Südpolar-Expedition, 1901–1903. Deutsch. Südpolar Exp. 1901–1903. **8**: 21. *pl. 3–5.*

Zirkle, C. 1930. The use of N-butyl alcohol in dehydrating woody tissues. Science N. S. **71**: 103–104.

* Not seen.

Verrucariaceae

Thallus crustose, epi- or endophloedal or more frequently saxicolous or terricolous, ecorticate; algae *Protococcus,* more rarely *Palmella* in *Staurothele* and *Thelenidia,* penetrating the perithecium which is simple, erect, sessile or with the base immersed, wall carbonaceous, entire or dimidiate, ostiole more or less prominent with a shield in *Aspidothelium* and *Aspidopyrenium;* asci mostly 8-spored, many-spored in *Trimmatothele;* paraphyses early gelified and evanescent in one tribe, persistent in the other; ascospores variable in color and septation.

Only *Verrucaria* (spores simple) and *Thelidium* (spores 2–4-celled) have been reported from the Antarctic. Eight species of the former from the Antarctic Archipelago and two

(perhaps three) species of the latter are here reported from Marie Byrd Land.

THELIDIUM

Thelidium Massalongo, Framm. Lich. 15. 1855.

Phragmothele Clements, Gen. Fung. 39. 1909.

The type species was not designated. Of the four species originally placed here, Clements & Shear, Gen. Fung. 288. 1931, chose *T. amylaceum* Mass. *Phragmothele* was based on *P. papulare* (Fr.) Clem.

Thallus crustose, simple, ecorticate, poorly developed and often with the perithecia sessile on the crustose thalli of other lichens; algae *Protococcus;* perithecia simple, horny, carbonaceous, partly immersed or sessile; paraphyses early gelified and evanescent; asci saccate, 8-spored; ascospores ellipsoid or ovoid, hyaline or dark, 2–4-celled, commonly with a large oil droplet.

Two of our Antarctic species agree with the generic descriptions of *Thelidium,* except as to the color of the spores which are dark and the cells often of unequal size. While these differences may warrant the creation of a new genus, we prefer to leave these species in *Thelidium,* as *Verrucaria, Polyblastia,* and *Staurothele* also contain both colored and hyaline spores.

Thelidium **inaequale** Dodge & Baker, sp. nov.

Pl. 38, figs. 1–5.

Type: Marie Byrd Land, Edsel Ford Range, Mt. Donald Woodward, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff DW-5.*

Areolae assimilantes minutae, granulares, gelifactae, cremeae, evanescentes; algis protococcoideis hyphisque paucis.

Perithecia 90–170 × 90–145 μ, abundantia, irregulariter elongata vel hemispherica, sessilia sed nonnumquam subtus attenuata, appressa, saxicola, sparsa vel gregaria, nigra, gelifacta madefacta, pseudoparenchymatica, cellulis pachydermaticis; hypothecium paraphysesque non visa; asci 30–38 × 21–23 μ, irregulares, saccati, e basi orientes; sporae octonae, 10–13 × 5–7 μ, uniseptatae, obtusae, constrictae, una ex cellulis majore quam altera, obscurae.

Assimilative areolae microscopic, rather gelatinous, granular, cream-colored, consisting only of algae abundant although

small, and occasional hyphae, probably evanescent as the granules are rare on portions of the rock where the perithecia are abundant.

Perithecia 90–170 × 90–145 μ, distributed over areas of several square centimeters, abundant, sessile but sometimes more or less basally attenuated, closely attached to rocks, scattered or in clusters but never in very close contact, black, dull, rather gelified when moist, of thick-walled pseudoparenchymatous cells; hypothecium not extensive; asci apparently rising from the center of the base; paraphyses not seen; asci 30–38 × 21–23 μ, 8-spored, very irregular, saccate without a sheath or with a very thin one; ascospores 10–13 × 5–7 μ, 2-celled, blunt, slightly to much constricted at the septum, one cell frequently larger than the other, dark.

On biotite-sericite and sericite-orthoclase schist.

MARIE BYRD LAND: Edsel Ford Range, Mt. Donald Woodward, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff DW-5;* Lichen Peak, *P. Siple & S. Corey 73-10.*

THELIDIUM **Caloplacae** Dodge & Baker, sp. nov.

Pl. 38, figs. 6–10.

Type: Marie Byrd Land, Edsel Ford Range, Mt. Donald Woodward, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff DW-4.*

Perithecia sessilia vel basi subimmersa, ad 150 μ diametro, subspherica, nigra, carbonacea, laevia (sub lente irregularia); ostiola non bene evoluta, murus 20–50 μ crassitudine; cortex 10–40 μ, cellulis magnis, pachydermaticis, obscure brunneis vel nigris, media parte 10–15 μ crassitudine, pseudoparenchymatica, leptodermatica, strato interiore cellulis parvis numerosis ad ostiolam periphyses gignentibus; ostiola parva, centrica; thecium basale, paraphyses desunt; asci 42–50 × 15–19 μ, elongato-clavati, vaginati, polyspori; sporae 6.5–7 × 3–4 μ, bicellulares, brunneae.

Perithecia sessile on the host, thallus or base slightly immersed, up to 150 μ in diameter, subspherical, black, carbonaceous, macroscopically appearing smooth, microscopically somewhat irregular, ostiole poorly defined, small, central, wall 20–50 μ thick; cortex 10–40 μ thick, of large thick-walled cells, dark brown to black, middle layer 10–15 μ thick, of lighter-colored, thin-walled pseudoparenchyma, innermost layer lining the perithecial cavity, of numerous small cells, better de-

veloped near the ostiole where they fray out into more or less periphysis-like structures; thecium basal, paraphyses absent; asci 42–50 × 15–19 μ, elongate-clavate with a prominent sheath, many-spored; spores 6.5–7 × 3–4 μ, 2-celled, not constricted at the septum, more or less pointed to blunt, brown.

Parasitic on the thalli of *Gasparrinia Siplei* and *Kuttlingeria rufa,* growing over biotite sericite and orthoclase-sericite-siderite schist.

The systematic position of this species is uncertain, as it is not clear whether the algae in the vicinity of the perithecia belong to the parasite or to the host. If the latter view is correct, it may belong in *Amphisphaeria* Ces. & Ntrs.

MARIE BYRD LAND: Edsel Ford Range, Mt. Donald Woodward, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff DW-2, DW-4,* type; Skua Gull Peak, *P. Siple & S. Corey 72W-6.*

THELIDIUM **parvum** Dodge & Baker, sp. nov.

Pl. 62, figs. 393–395.

Type: Marie Byrd Land, Edsel Ford Range, Skua Gull Peak, *P. Siple & S. Corey 72W-4.*

Thallus minimus, hyphis brunneis, 2–4 μ diametro; algis *Scytonema* et *Protococcus,* cellulis ad 12 μ diametro.

Perithecia ad 50 × 55 μ, subsphaerica, parva, obscure brunnea, ostiolata, muro subaspero, 7–10 μ crassitudine, cellulis compactis, obscuris, pachydermaticis, isodiametricis; paraphyses desunt, deliquescentes; asci 28–31 × 10–12 μ, subbasales, elongati, subclavati, evaginati; ascosporae octonae, 7.5–9 × 3–3.5 μ, uniseptatae, cellula una majore obtusoque, altera minora, subacuta, hyalinae.

Non-assimilative parts lacking, assimilative thallus extremely reduced, hyphae slightly brownish, 2–4 μ in diameter, surrounding miscellaneous algae principally *Scytonema* and *Protococcus* with cells up to 12 μ in diameter. Sometimes a few colonies of bacteria are present.

Perithecia up to 50 × 55 μ, subspherical, small, very inconspicuous dark brown, ostiolate above, wall somewhat rough, 7–10 μ thick, of compact dark cells, thick-walled, isodiametric; no paraphyses seen, probably deliquescing early, leaving gelified slimy strands among the asci which are 28–31 × 10–12 μ, more or less limited to the basal region, elongate, somewhat

clavate, 8-spored, without a gelified sheath; ascospores 7.5–9 × 3–3.5 μ, 2-celled, not constricted at the septum, one cell larger and blunt at the end, the other smaller, more pointed, each cell uninucleate, hyaline.

The symbiotic relations and hence the systematic position of this species are puzzling. The fungous hyphae seem to be involving two groups of algae, either as parasites or symbionts and growing over the thallus of *Parmelia variolosa,* on sandy loam from leucogranite. As in *T. Caloplacae,* we have preferred to leave this species with the lichens until more is learned of its life history.

MARIE BYRD LAND: Edsel Ford Range, Skua Gull Peak, *P. Siple & S. Corey 72W-4.*

LECIDEACEAE

Thallus crustose, simple or with effigurate margins, continuous, areolate to squamulose (in *Lecidea* sect. *Psora)* and dwarf-fruticose (in *Sphaerophoropsis),* attached to the substrate by the hyphae of the hypothallus or of the medulla without differentiated rhizinae, often decorticate, ecorticate, or with an incomplete cortex of fasciculate thick-walled hyphae, never pseudoparenchymatous; algal layer of *Protococcus* cells, rarely producing many cells in a colony before the wall disappears, giving somewhat the appearance of a *Gloeocapsa;* medulla loosely woven with basal layer not differentiated or suggesting the structure of the upper cortex. Apothecia round, sessile, occasionally immersed or with a very short stalk, with parathecium hyaline or carbonaceous, not surrounded by an amphithecium nor including medullar tissue; hypothecium hyaline to carbonaceous; paraphyses usually simple, but branched in most of our Antarctic species, either free or imbedded in a gel; asci usually 8-spored, only exceptionally with fewer than 8 in *Mycoblastus* and *Megalospora,* or more (16–32 in a few species of *Lecidea* and *Bacidia);* ascospores usually hyaline, rarely brown *(Rhizocarpon),* of a variable number of cells, with or without a gelified sheath. Spermagonia immersed, spermatia elongate-ellipsoidal to cylindrical.

KEY TO ANTARCTIC GENERA

Spores unicellular .... *Lecidea*
Spores 2-celled, under 30 μ long.
  Spores without a conspicuous sheath, long, hyaline .... *Catillaria*
  Spores with a conspicuous sheath, hyaline or brown .... *Catocarpon*
Spores several-celled, usually finally muriform, with a conspicuous sheath ....
.... *Rhizocarpon*

LECIDEA

LECIDEA Acharius, Meth. Lich. 32. 1803.

No type species was designated.

Thallus crustose, simple, continuous, areolate, verrucose or squamulose (in sect. *Psora),* attached to the substrate by hyphae of the hypothallus or of the medulla, without true rhizinae, ecorticate or with a thin cortex, sometimes sorediose, very rarely with true soralia or cephalodia; algae *Protococcus.* Apothecia round or angled by mutual pressure, exceptionally slightly elongate, immersed, sessile or very short-stalked, with hyaline, colored, or black parathecium of closely woven hyphae, epithecium bright or black; hypothecium hyaline, colored or carbonaceous; paraphyses unbranched in most temperate species but often branched in the Antarctic ones, with more or less thickened and capitate tips, free or imbedded in a gel; asci usually 8-, rarely 16-, spored; ascospores hyaline, unicellular, small, spherical, ovoid, ellipsoid or allantoid, straight or somewhat curved with a thin wall (or thickened with more or less of a sheath in the Antarctic species). Spermogonia immersed with a dark mouth, spherical, spermatia short-cylindric to filiform, straight or curved.

This large genus of the cold and temperate zones is usually divided into three sections often recognized as genera: *Eulecidea,* thallus simple, parathecium carbonaceous; hypothecium either carbonaceous or hyaline, of the colder regions; *Biatora,* thallus simple, parathecium and hypothecium never carbonaceous, varying from hyaline to colored, of the temperate regions; and *Psora,* thallus squamose, margin effigurate, parathecium either colored or black, mostly in the warmer, semiarid regions. Of these, two species of *Psora* have

been reported from the Antarctic Archipelago, five species of *Biatora* from Louis Philippe and Graham Lands and twelve species of *Eulecidea,* of which two have been found in South Victoria Land, the rest from the Antarctic Archipelago.

KEY TO ANTARCTIC SPECIES

Thallus not effigurate, uniform.
 Apothecia bright-colored, not carbonaceous........................... BIATORA
  Thallus flesh-color.. *L. lavae*
  Thallus white.. *L. poeciloderma*
  Thallus yellowish, granulose................................... *L. theiochroa*
  Thallus pale straw-color, areolate.
   Margin of thallus black.................................... *L. monocarpa*
   Margin of thallus concolorous........................... *L. acervuligera*
 Apothecia black, carbonaceous.................................. EULECIDEA
  Thallus deep grayish, brown or fuscous.
   Spores less than 10 μ; hypothecium hyaline; thallus fusco-rufous.......
   .... *L. brunneoatra*
   Spores more than 10 μ.
    Apothecia 1 mm. or more.
     Thallus thick, hypothecium black...................... *L. atrobrunnea*
     Thallus thin, poorly developed.......................... *L. fuscoatra*
    Apothecia less than 1 mm.; thallus 0.4–0.5 mm.
     Thallus grayish... *L. cinericia*
     Thallus brownish....................................... *L. rufonigerrima*
  Thallus citrine drab to pale olive buff........................ *L. Blackburni*
  Thallus white to pale yellowish, sometimes stained ferruginous when growing over ferriferous rocks.
   Apothecia over 2 mm. in diameter.......................... *L. auriculata*
   Apothecia up to 1.5 mm. in diameter...................... *L. cancriformis*
   Apothecia 1 mm. or less in diameter.
    Hypothecium dark fuscous to brown.
     Spores 10–16 × 5–8 μ; hypothecium 100–150 μ.
      Cortex not differentiated; apothecia 0.315 mm.; thecium 60 μ; paraphyses 0.5–1.5 μ, tips 2 μ.................... *L. ecorticata*
      Cortex 30–60 μ; apothecia 0.6–1.0 mm.
       Thecium 100–120 μ; paraphyses 5–6 μ, tips not thickened......
       .... *L. cremoricolor*
       Thecium 140–160 μ; paraphyses 3 μ, tips furcate...... *L. sciatrapha*
     Spores 7.5–10 μ long; epithecium K green.
      Spores 2–3 μ in diameter; thecium 30–40 μ; asci short-clavate, base not attenuate, 24–28 (–32) × 12.5–14 μ........... *L. Coreyi*
      Spores 5–6 μ in diameter; thecium 60 μ.................. *L. rupicida*
     Spores 6–8.5 μ long; epithecium K green.
      Spores 1.7–2.5 μ in diameter.

Asci 25–42 μ, inflated above, attenuate below; hypothecium 100 μ with long strands penetrating the medulla....... ....*L. cancriformis*

Asci (37–) 52–60 μ, not inflated; hypothecium 60–70 μ, not penetrating the medulla.....................*L. Blackburni*

Spores 3.5–5 μ in diameter; asci 23–31 × 6–9 μ.............*L. Painei*

Hypothecium hyaline.

Spores 10–20 μ long.

Spores 3–5 μ in diameter; asci (20–)32–40 × 12.5–16 μ; thecium 60–70 μ; epithecium K green.......................*L. Wadei*

Spores 5–8.5 μ in diameter.

Paraphyses 1.0–1.5 μ, not capitate; epithecium K–; asci 30–44 × 14–16(–20) μ...............................*L. Byrdii*

Paraphyses 0.75–1.0 μ, capitate; epithecium K green; asci (41–)48–62(–70) × 15–18 μ.......................*L. Siplei*

Paraphyses 3–4 μ, not capitate.....................*L. eburnea*

Spores 7–11 μ long.

Spores 5–6 μ in diameter; epithecium K–; thecium 55–60 μ.

Apothecia 0.3–0.5 mm.; spores 8–10 μ long.............*L. rupicida*

Apothecia 0.675 mm.; spores 10–11 μ long..............*L. Byrdii*

Spores 3–5 μ in diameter; epithecium K green.

Thecium 50–60 (–70) μ; apothecia 0.225 mm.; paraphyses 0.75–1–1.5 μ, not capitate..........................*L. capsulata*

Thecium 70 μ; apothecia 0.60 mm.; paraphyses 1.5–2.5 μ, capitate, heads 4–5 μ.............................*L. Stancliffi*

Thallus effigurate; apothecia black; hypothecium hyaline.................PSORA

Thallus cupreous to dark chestnut, non-assimilative thallus slightly developed, fibrillose...................................*L. placodiiformis*

Thallus light yellow to light chestnut, with a broad black non-assimilative border...*L. physciella*

Lecidea **Siplei** Dodge & Baker, sp. nov.

Pl. 39, figs. 22–28; pl. 63, fig. 410.

Type: Marie Byrd Land, Edsel Ford Range, Skua Gull Peak, *P. Siple & S. Corey 72W-4.*

Thallus plus minusve continuus, ad 1.5 cm. diametro, areolae ad 1.8 mm., deinde diffractae, granulosae vel verrucosae, gelifactae madefactae, albae vel griseae, in solo una cum muscis; cortex 10–30 μ crassitudine, hyphis periclinalibus, extremis emortuis gelifactis amorphisque; stratum gonidiale ad 85 μ crassitudine, cellulis singulis 10–11 μ diametro; medulla ad 450 μ crassitudine, hyphis reticulatim laxeque intertextis; stratum basale non bene evolutum, paullo densius obscuriusque.

Apothecia ad 0.9 mm. diametro, maturitate convexa, marginibus juventute inflexis, irregulariter spherica, sparsa vel gregaria, carbonacea, marginibus 10–20 μ, cellulis obscuris fastigiatis; parathecium 20–40 μ, cellulis obscuris, fastigiatis isodiametricisve, subtus tenuescens et cum cortice mergens; hypothecium 50–70 μ, hyalinum, pseudoparenchymaticum, non in lateribus tenuescens, basaliter in medullam

filamentosam cellulis tenuibus laxe implexis ad 100 μ crassitudine mergens, totam super medullam areolarum; thecium 50–100 μ altitudine; paraphyses 0.75–1.0 μ, apicibus inflatis, 1–1.5 μ, raro ramosi, graciles, septati, epithecium ad 15 μ crassitudine, carbonaceum; asci (41–)48–62(–70) × 15–20(–22) μ, elongati, graciles, clavati, conspicue vaginati; ascosporae octonae, 10–14 × 5.0–8.5 μ, hyalinae, late ellipsoideae, raro subovoideae, unicellulares.

Thallus more or less continuous over areas of a few mm. to 1.5 cm., broken up into areolae up to 1.8 mm., crustose with secondary cracks, granulose to verrucose, gelified when wet, white or grayish, on soil with mosses; cortex 10–30 μ thick, of periclinal hyphae, the outer ones dying, becoming gelified and amorphous; algal layer up to 85 μ thick, cells occurring singly, 10–11 μ in diameter; medulla up to 450 μ thick, of reticulate hyphae loosely interwoven; basal cortex scarcely differentiated, here and there slightly denser and darker.

Apothecia up to 0.9 mm. in diameter, convex at maturity, often with inrolled margins when young, irregularly spherical, sessile, scattered or gregarious, carbonaceous; exciple 10–20 μ, of dark fastigiate cells; parathecium 20–40 μ, of dark fastigiate or isodiametric cells, thinning below and merging with the thalline cortex; hypothecium 50–70 μ thick, of hyaline pseudoparenchyma, not thinning laterally, basally passing into a filamentous medulla of very fine, loosely arranged cells for about 100 μ before merging with the coarser reticulate medulla of the assimilative areolae; thecium 50–100 μ high; paraphyses 0.75–1.0 μ, expanding to 1–1.5 μ at the tips, rarely branched, fine, septate, apices delicately inflated, united into a carbonaceous layer, small bits of which often cling to the outer surfaces, heads small, gelified, not darkened, epithecium up to 15 μ thick, carbonaceous; asci (41–)48–62(–70) × 15–20(–22) μ, 8-spored, elongate, slender, clavate with a conspicuous gelified sheath; ascospores 10–14 × 5.0–8.5 μ, hyaline, broadly ellipsoid to somewhat ovoid, 1-celled.

On loose sandy soil from biotite-sericite, sericite-orthoclase schist, and orthoclase-sericite-siderite schist.

MARIE BYRD LAND: Edsel Ford Range, Mt. Donald Woodward, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff DW-1, DW-3;* Stancliff Mt., *P. Siple & S. Corey 72A-1;* Skua Gull Peak, *P. Siple & S. Corey 72W-4,* type; Lichen Peak, *P. Siple & S. Corey 73-3, 73-4, 73-7.*

Lecidea **Wadei** Dodge & Baker, sp. nov. Pl. 39, figs. 18–21.

Type: Marie Byrd Land, Mt. Rea-Cooper, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff R-6.*

Thallus parvus, inconspicuus, in solo inter muscos, areolatus vel granulosus, gelifactus madefactus, albus vel pallide stramineo-flavus; cortex superior evanescens, paucis cellulis obscuris relictis, superficie thalli catervis cellularum emortuarum tecta; stratum gonidiale variabile, coloniis compactis, numerosis, sparsis; medulla ad 150 μ crassitudine, hyphis circa 1 μ diametro, reticulatim laxeque dispositis; stratum basale male evolutum, subamorphum gelifactumque cum bacteriis algisque extraneis.

Apothecia circa 0.675 mm., raro ad 0.9 mm. diametro, irregulariter hemispherica, juventute applanata, sessilia, sparsa vel gregaria, carbonacea; parathecium 20–30 μ crassitudine, paucis cellulis fastigiatis, exteris obscuris, cum epithecio mergens; hypothecium 20–30 μ, hyalinum, hyphis tenuibus, compactis, basaliter cum medulla mergens; thecium ad 60 μ altitudine; paraphyses 0.75–1.0 μ, apicibus ad 2 μ diametro, tenuissimi, vaginati, epithecium 8–10 μ crassitudine, KOH addito viridescens, obscuri; asci 32–40 × 12.5–16 μ, obtuse clavati, apicibus vaginatis; ascosporae octonae, 11–14 × 3–5 μ, elongato-ellipsoideae, juventute subsphericae, vaginatae, hyalinae, unicellulares.

Thallus scant, only a few mm. in diameter, inconspicuous, on soil among mosses, areolate to granulose, gelified when moist, white to pallid straw yellow; upper cortex poorly represented by occasional dark fastigiate cells, rarely more than one cell thick, outer surface usually decorticate, covered by extensive masses of dead cells; algae in compact groups in the upper portions of the thallus, surrounded by hyphae more closely united than in the medullar tissue, numerous; medulla up to 150 μ thick, of loosely reticulate hyphae about 1 μ in diameter; basal cortex not differentiated, but with a distinct basal zone from 40 to 300 μ thick, structure indistinct, almost amorphous, perhaps gelified, in the upper portions with a few medullar hyphae which can still be traced, abundantly packed with clumps of bacteria and a few algae.

Apothecia about 0.675 mm., rarely up to 0.9 mm. in diameter, irregularly hemispheric, flatter when young, sessile on the assimilative thallus, scattered or gregarious, carbonaceous; parathecium 20–30 μ thick, of a few fastigiate cells, darkened on the outside, merging with the epithecium; hypothecium 20–30 μ thick, hyaline, of slender compact hyphae, not thinning laterally, basally uniting with the medulla which is truly

reticulate and filamentous; thecium up to 60 μ tall; paraphyses 0.75–1.0 μ in diameter, expanding above to 2 μ, covered by a sheath but the sheath not much darkened nor expanded at the tip, very slender, septate, unbranched or branched, the whole forming a rather gelified mass; epithecium 8–10 μ, turning green with KOH, dark; asci 32–40 × 12.5–16 μ, 8-spored, bluntly clavate at maturity with a well-developed apical sheath; ascospores 11–14 × 3–5 μ, nearly spherical when young, elongate-ellipsoidal at maturity, covered with a delicate sheath which is more prominent in immature spores, hyaline, unicellular.

Among mosses on loose sandy loam from leucogranite.

MARIE BYRD LAND: Edsel Ford Range, Mt. Rea-Cooper, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff R-6.*

LECIDEA **capsulata** Dodge & Baker, sp. nov.

Pl. 38, figs. 11–17.

Type: Marie Byrd Land, Edsel Ford Range, Mt. Stancliff, *P. Siple & S. Corey 72A-2.*

Thallus sparsus in areis 1–3 cm. diametro, saxicola, floccosus vel arachnoideus, plus minusve continuus; areolae ad 0.45 mm. diametro, irregulares, albae vel "cartridge buff" aut ochraceae a saxis ferriferis tinctae; cortex deest vel paucis cellulis fastigiatis relictis; stratum gonidiale ad 50 μ crassitudine, coloniis parvis paucisque, sparsis; medulla hyphis laxe reticulatimque contexta, 1 μ diametro; stratum basale non evolutum.

Apothecia ad 0.225 mm. diametro, irregulariter circularia, applanata vel concava, marginata, juventute subcyathiformia, sessilia, sparsa, nigra, nitida; parathecium ad 40 μ crassitudine, cellulis magnis fuscis pachydermaticis, hypothecium theciumque circumdans; hypothecium ad 30 μ crassitudine, hyalinum vel subobscurum, hyphis tenuibus periclinalibus pachydermaticis; thecium ad 70 μ altitudine; paraphyses 0.75–1.5 μ diametro, septati, ramosi insuper, tenues, flexuosi, vaginati, epithecium 5–8 μ, obscurum, KOH addito virescens; asci (20–) 30–42 × 12–16 μ, breves, late clavati, vaginati; ascosporae octonae, 7–11 × 3–4.5 μ, hyalinae, ellipsoideae, vaginatae, unicellulares.

Thallus scattered over areas 1–3 cm. in diameter, on rocks, floccose to arachnoid and more or less continuous or of separate areolae scattered over the rock, individual areolae up to 0.45 mm. in diameter, irregular in shape, white to cartridge buff or stained by rust from the rocks; upper cortex evanescent except for an occasional group of fastigiate cells; algal layer up to 50 μ thick, of small and few scattered colonies; medulla of

loose reticulate hyphae about 1 μ in diameter which are slightly more compact and abundant around the algae; no basal layer differentiated.

Apothecia up to 0.225 mm. in diameter, irregularly circular, flat or concave with a margin, especially so when young, almost cyathiform, sessile on the assimilative thallus, scattered, black and shining; parathecium highly developed, up to 40 μ thick, entirely surrounding the thecium and hypothecium, of large fuscous thick-walled cells in a palisade, forming the cortex as well, basally distinct from the medulla which is more compact below the apothecium but with the cells no larger in diameter; hypothecium up to 30 μ thick, even, thinning somewhat laterally and merging into the parathecium; thecium up to 70 μ tall; paraphyses 0.75–1.5 μ in diameter, septate, branched often more than once near the tip, slender, slightly flexuous with a thin sheath, neither much expanded nor darkened at the tip, epithecium 5–8 μ, dark, turning green with KOH; asci (20–)30–42 × 12–16 μ, 8-spored, short, broadly clavate with a conspicuous gelified sheath which is distinct from an early stage; ascospores 7–11 × 3–4.5 μ, hyaline, ellipsoidal with a conspicuous gelified sheath.

The specimen from Mt. Rea-Cooper has apothecia up to 0.65 mm. but agrees microscopically and grows on leucogranite.

On biotite-sericite, sericite-orthoclase schist, quartzite, and leucogranite.

MARIE BYRD LAND: Edsel Ford Range, Mt. Donald Woodward, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff DW-3, DW-5;* Mt. Stancliff, *P. Siple & S. Corey 72A-1, 72A-2,* type; Lichen Peak, *P. Siple & S. Corey 73-10;* Chester Mts., *P. Siple & S. Corey 97A-3;* Mt. Rea-Cooper, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff R-7.*

LECIDEA **Coreyi** Dodge & Baker, sp. nov. Pl. 40, figs. 29–34.

Type: Marie Byrd Land, Edsel Ford Range, Lichen Peak, *P. Siple & S. Corey 73-6.*

Thallus paucis mm. diametro, bene evolutus, tenax, gelifactus madefactus, irregulariter areolatus, saxicola, albidus; cortex cellulis fastigiatis, non continuus, saepe cum strato cellularum emortuarum aut funiculis amorphis plus minusve periclinalibus; stratum gonidiale 55–60 μ crassitudine, coloniis minutis sparsisque, cellulis 7–8 μ diametro; medulla hyphis laxe reticulatimque implexis; stratum basale non bene evolutum, simile cortici sed crassius.

Apothecia ad 0.50 mm. diametro, subspherica, convexa, sessilia, singula vel caespitosa, carbonacea, nigra; parathecium ad 200 μ crassitudine, cellulis fuscis pachydermaticis, ad 5 μ diametro; hypothecium inconspicuum, 10–20 μ crassitudine cum parathecio continuum, cellulis pseudoparenchymaticis; thecium 30–40 μ altitudine; paraphyses 1–2.5 μ diametro, apicibus ad 2.5 μ, pachydermatici, septati, ramosi vel non-ramosi, vaginati, capitibus non obscuris vel incrustatis, epithecium 5–8 μ, nigrum, KOH addito viridescens; asci 24–28(–32) × 12.5–14 μ, parvi, breve clavati, vagina non prominente; ascosporae octonae, monostichae, elongato-ellipsoideae, late vaginatae, 7.5–10 × 2–3 μ.

Thallus scant, a few mm. at most in diameter, well developed, tough, gelified when moistened, irregularly areolate, on rocks, whitish; cortex of fastigiate cells, not continuous, often with a conspicuous layer of dead cortical cells covering the outer surface, seemingly built of amorphous strands, more or less periclinal; algal layer 55–60 μ thick, of small scattered colonies, cells 7–8 μ in diameter; medulla of loosely reticulate hyphae; basal layer not morphologically distinct from the cortex, although frequently a few layers thicker.

Apothecia up to 0.50 mm. in diameter, subspherical in outline, convex, not flattened, sessile on the assimilative areolae, single to closely clustered and heaped, carbonaceous, black; parathecium up to 200 μ thick, of heavy-walled fuscous cells up to 5 μ in diameter in a conspicuous concentric palisade, disappearing abruptly below into the thinner-walled hyaline cells of the medulla; hypothecium inconspicuous, 10–20 μ thick, continuous with the parathecium, of thick-walled fuscous cells nearly isodiametric; thecium 30–40 μ high; paraphyses 1–2.5 μ in diameter, expanding slightly to 2.5 μ at the tips, thick-walled, septate, branched or unbranched, gelified sheath prominent, tips not darkened or incrusted; epithecium 5–8 μ thick, dark turning green with KOH; asci 24–28(–32) × 12.5–14 μ, 8-spored, small, short-clavate, especially at maturity, sheath not prominent; spores monostichous, 7.5–10 × 2–3 μ, elongate-ellipsoidal with a broad sheath.

On coarse- or fine-grained crypto-crystalline pinkish-gray granite, sericite-orthoclase schist, and arkosic sandstone.

MARIE BYRD LAND: Edsel Ford Range, Lichen Peak, *P. Siple & S. Corey 73-6*, type; Mt. Grace McKinley, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff McK-2, McK-3, McK-5*.

LECIDEA **Byrdii** Dodge & Baker, sp. nov. Pl. 40, figs. 39–41.

Type: Marie Byrd Land, Edsel Ford Range, Garland Hershey Ridge, *P. Siple & S. Corey 5-2.*

Thallus parvus, sparsus, crustosus, areolatus, albidus; cortex non evolutus, superficies thalli strato cellularum emortuarum ad 20 μ crassitudine tecta; algae protococcoideae, ad 12 μ diametro, coloniis magnis per totum thallum dispositis; medulla hyphis tenuibus circa 2 μ diametro reticulatim dispositis, sub apotheciis verticaliter et plus minusve parallele dispositis; stratum basale non evolutum.

Apothecia ad 0.675 mm. diametro, irregularia, pulvinata, sessilia, nigra, carbonacea; parathecium non bene evolutum; hypothecium 20–30 μ crassitudine, non tenuescens, hyphis tenuibus dense reticulatis, hyalinum; thecium 40–60 μ altitudine; paraphyses 1–1.5 μ diametro, apicibus non inflatis, septati, raro ramosi, vaginati, epithecium 5–8 μ, carbonaceum, asperum; asci 30–44 × 14–20 μ, late clavati, obtusi, tenuiter vaginati; ascosporae octonae, 10–11 × 5–6 μ, late ellipsoideae, apicibus obtusis, juventute conspicue, maturitate tenuiter, vaginatae.

Thallus a few mm. in diameter, scattered, scant, crustose, areolate, whitish, closely attached to the rock; upper cortex lacking, the outer surface protected by a layer of dead cells as much as 20 μ thick; algae *Protococcus,* cells up to 12 μ in diameter abundant, in large colonies throughout the areolae; medulla of slender hyphae about 2 μ in diameter, closely anastomosed in loosely woven strands, near the surface hyphae more coarsely reticulate and apparently devoid of contents, medullar hyphae below the apothecia more or less parallel and vertical; lower cortex not differentiated.

Apothecia up to 0.675 mm. in diameter, irregularly circular in outline, pulvinate, sessile, black, carbonaceous; parathecium not differentiated beyond a few cells which merge with the marginal cells; hypothecium 20–30 μ thick, not tapering, of slender, closely reticulate hyphae, hyaline; thecium 40–60 μ tall; paraphyses 1–1.5 μ in diameter, tips not expanded, septate, rarely branched, with a thin gelified sheath and black incrustations adhering to the outer surfaces, epithecium 5–8 μ, carbonaceous, rough; asci 30–44 × 14–20 μ, 8-spored, broadly clavate, blunt on the ends, with a small gelified sheath; ascospores 10–11 × 5–6 μ, broadly ellipsoid, ends blunt, surrounded by a hyaline sheath which is especially prominent on the young spores but decreases with maturity.

MARIE BYRD LAND: Edsel Ford Range, Garland Hershey Ridge, *P. Siple & S. Corey 5-2.*

LECIDEA **ecorticata** Dodge & Baker, sp. nov.

Pl. 40, figs. 35–38.

Type: Marie Byrd Land, Edsel Ford Range, Mt. Rea-Cooper, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff R-7(1).*

Thallus minimus, 0.5 mm. diametro, pustularis, irregulariter areolatus, gelifactus madefactus, albus vel dilute olivaceo-alutaceus; cortex non evolutus; algae paucae, sparsae ad superficiem; medulla laxa, hyphis reticulatim dispositis; stratum basale cellulis fastigiatis obscuris.

Apothecia ad 0.315 mm., juventute concava, maturitate subconvexa, saepe submarginata, sparsa, sessilia, nigra, carbonacea; parathecium ad 25 μ, ad margines tenuescens, 5–10 μ; hypothecium ad 150 μ, obscurum, pseudoparenchymaticum; thecium ad 60 μ altitudine; paraphyses 0.5–1.5 μ crassitudine, graciles, apicibus ad 2 μ, non obscuris, ramosi vel non ramosi, vaginati, brunnei, gelifacti, epithecium 8–10 μ, obscurum; asci 40–48 × 19–22 μ, bulbosi, basi attenuato, vaginati; ascosporae octonae, 10–14 × 5–7 μ, ellipsoideae vel ovoideae, vaginatae, hyalinae, unicellulares.

Thallus small, not more than 0.5 mm. in diameter, pustular, irregularly areolate, gelified when moist, white to pale olive buff; upper cortex not differentiated; algae few, scattered near the upper surface; medulla of loose reticulately woven hyphae; basal cortex of darkened fastigiate cells sometimes extending into the medulla up to 30 μ.

Apothecia up to 0.315 mm. in diameter, concave when young to slightly convex at maturity, often with a slight rim, mostly scattered, sessile on the assimilative thallus; parathecium distinct up to 25 μ, tapering to 5–10 μ at the point of convergence with the epithecium; hypothecium up to 150 μ, tapering slightly from the center to the margin, dark, more or less pseudoparenchymatous; thecium about 60 μ tall; paraphyses 0.5–1.5 μ, slender, slightly expanded, the tips sometimes up to 2 μ, not darkened, branched or unbranched with prominent sheath, the whole rather gelified, brownish, epithecium 8–10 μ thick, dark; asci 40–48 × 19–22 μ, 8-spored, bulbous with a somewhat attenuate base, sheath prominent from early stages; ascospores 10–14 × 5–7 μ, ellipsoidal to ovoid with a distinct hyaline sheath, hyaline, unicellular.

On coarse-grained gray granite.

MARIE BYRD LAND: Edsel Ford Range, Mt. Rea-Cooper, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff R-7, R-7 (1),* type.

Lecidea **Stancliffi** Dodge & Baker, sp. nov.

Pl. 40, fig. 42; pl. 41, figs. 43–45.

Type: Marie Byrd Land, Edsel Ford Range, Lichen Peak, *P. Siple & S. Corey 73-10.*

Thallus parvus, 3–4 mm. diametro, plus minusve areolatus, albus vel cremeo-alutaceus; cortex ad 40 μ, cellulis obscuris fastigiatis irregularibus, saepe strato cellularum emortuarum ad 40 μ crassitudine tectus; stratum gonidiale 50–170 μ crassitudine, cellulis coloniisque subverticaliter dispositis; medulla ad 650 μ crassitudine, hyphis laxe reticulatimque implexis; stratum basale non evolutum sed hyphis medullaribus inferis subobscuris, non pachydermatiscens.

Apothecia ad 0.6 mm. diametro, circularia, applanata, marginata vel emarginata, gregaria vel caespitosa, nigra, nitida; parathecium non evolutum; hypothecium ad 30 μ, hyalinum, hyphis leptodermaticis periclinalibus compactis; thecium ad 70 μ altitudine; paraphyses 1.5–2.5 μ, apicibus obscuris, 4–5 μ, septati, ramosi, raro non ramosi, pachydermatici, epithecium ad 10 μ crassitudine, obscurum, subgelifactum, KOH addito dilute virescens; asci 36–45 × 14–15 μ, late clavati; ascosporae octonae, (7–)8–10.5 × 3.5–5(–6) μ, ovoideae vel subsphericae, vaginatae.

Thallus 3–4 mm. in diameter, scant, compact, more or less areolate, white to cream-buff; upper cortex up to 40 μ thick, of darkened fastigiate cells, at most a few rows deep and irregularly distributed, often covered by a conspicuous layer of dead cortical cells as thick as 40 μ; algal layer 50–170 μ thick, individual cells and small colonies more or less vertically arranged; medulla up to 650 μ thick, of loosely reticulate hyphae; basal layer not developed but the medullar hyphae somewhat darkened, not thickened.

Apothecia up to 0.6 mm. in diameter, more or less circular, usually flattened, with or without a differentiated margin, closely gregarious or heaped, black, shining; parathecium not differentiated beyond a few cells merging with the margin; hypothecium up to 30 μ, hyaline, not tapering, of thin-walled more or less periclinal hyphae closely united; thecium up to 70 μ tall; paraphyses 1.5–2-5 μ, expanding to 4–5 μ above, septate, branched or rarely unbranched, thick-walled, heads with darkened outer caps, epithecium up to 10 μ thick, dark, slightly gelified, turning slightly greenish with KOH; asci 36–45 × 14–15 μ, 8-spored, broadly clavate; ascospores (7–)8–10.5 × 3.5–5(–6) μ, ovoid to subspherical, with a prominent sheath.

On cemented particles of crypto-crystalline gray granite and

weathered coarse pinkish or gray granite or on sericite-orthoclase schist.

MARIE BYRD LAND: Edsel Ford Range, Lichen Peak, *P. Siple & S. Corey 73-10*, type; Mt. Rea-Cooper, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff R-7;* Mt. Grace McKinley, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff McK-8.*

LECIDEA **cancriformis** Dodge & Baker, sp. nov.
Pl. 41, figs. 46–52; pl. 63, fig. 409.

Type: South Victoria Land, Queen Maud Mts., Scudder Mt., 86° 03′ S., 150° 40′ W., *Q. A. Blackburn, R. S. Russell Jr. & S. D. L. Paine QM-6(2).*

Thallus areolatus, ad 0.5 mm. latitudine, funiculis plura apothecia gerentibus, griseo-albidus, gelifactus madefactus, irregularis, plus minusve verrucosus; cortex 2–8 μ crassitudine, brunneus, cellulis parvis fastigiatis ad 2 μ diametro et strato cellularum emortuarum ad 40 μ diametro; stratum gonidiale ad 100 μ crassitudine, cellulis protococcoideis ad 10 μ diametro; medulla ad 1200 μ crassitudine, hyphis ad 2 μ, ad basim verticaliter, insuper reticulatim, dispositis.

Apothecia ad 1.5 mm., irregularia, saepe angulata, convexa vel pulvinata, emarginata, gregaria, nigra, carbonacea, basi constricta; parathecium paucis cellulis in cortice mergens; hypothecium ad 100 μ crassitudine, irregulariter in medullam ad 450 μ penetrans, cellulis pachydermaticis, 2 μ diametro, obscure fusco-brunneis, subparallelis, verticaliter dispositis; thecium ad 70 μ altitudine; paraphyses 1.0–1.5 diametro, capitibus 3.0–4.0 μ diametro, non ramosi vel ramosi, pachydermatici, septati, epithecium ad 10 μ crassitudine, carbonaceum, superficie irregulari, KOH addito virescens; asci 25–42 × 8–12 μ, subtus attenuati, superne inflati; ascosporae octonae, subfasciculatae, 6.5–7.5 × 1.7–2.5 μ, ellipsoideae, una apice subacuta.

Thallus up to 0.5 mm. wide, usually in long strands bearing several apothecia, areolate, grayish white, gelified when moist, irregular in shape, more or less verrucose, small and inconspicuous in comparison with the apothecia; upper cortex 2–8 μ thick, brownish, of small fastigiate cells up to 2 μ in diameter which terminate the hyphae of the medulla, with a thick layer of dead cells on the surface up to 40 μ thick; algal layer up to 100 μ thick, of protococcoid cells up to 10 μ in diameter; medulla up to 1200 μ thick, of reticulately arranged hyphae up to 2 μ in diameter, more or less vertical toward the base of the areolae; lower cortex not differentiated.

Apothecia up to 1.5 mm. in diameter, irregularly circular becoming angled by mutual pressure, convex to pulvinate, emarginate, abundant, gregarious, black, carbonaceous, constricted

at the base, subsessile to substipitate on the areolae; parathecium of a few cells which merge laterally with the marginal cortex; hypothecium up to 100 μ thick, extending irregularly into the medulla, occasionally as much as 450 μ, of dark fuscous brown cells about 2 μ in diameter, more or less parallel and vertical; thecium up to 70 μ tall; paraphyses 1.0–1.5 μ, expanding to heads 3.0–4.0 μ in diameter which are hyaline and incrusted with carbonaceous fragments unbranched or branched, thick-walled, septate, epithecium about 10 μ thick, carbonaceous, surface irregular, turning green with KOH; asci 25–42 × 8–12 μ, 8-spored, attenuate below, inflated above, giving a bulbous appearance to the mature ascus; ascospores subfasciculate, 6.5–7.5 × 1.7–2.5 μ, ellipsoidal, one end sometimes pointed.

On coarse-grained granite weathering reddish brown, and on fine-grained gray granite.

KING EDWARD VII LAND: Rockefeller Mts., Mt. Helen Washington, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff HW-8.*

SOUTH VICTORIA LAND: Queen Maud Mts., Scudder Mt., Station 9, 86° 03′ S., 150° 40′ W., *Q. A. Blackburn, R. S. Russell Jr. & S. D. L. Paine QM-2, QM-6 (1), (2),* type, *(3), (4);* N.E. Durham Point, east portal Thorne Glacier, *Q. A. Blackburn, R. S. Russell Jr. & S. D. L. Paine QM-3(84), QM-4(83).*

LECIDEA **Blackburni** Dodge & Baker, sp. nov.

Pl. 41, figs. 53–56.

Type: South Victoria Land, Queen Maud Mts., Scudder Mt., 86° 03′ S., 150° 40′ W., *Q. A. Blackburn, R. S. Russell Jr. & S. D. L. Paine QM-6(2).*

Hypothallus paucis obscuris funiculis hypharum irregularum; cortex medullaque non evoluta, areas 4–5 mm. diametro dendritice tegens; areolae assimilantes ad 0.75 mm. diametro, irregulares, molles vel gelifactae madefactae, pallide olivaceo-alutaceae vel citrino-ravae; cortex 10–18 μ, cellulis parvis fastigiatis dilute vel obscure brunneis, strato denso amorpho cellularum emortuarum ad 20 μ crassitudine tectus; stratum gonidiale 80–100 μ crassitudine, cellulis ad 15 μ diametro confertis; medulla ad 850 μ crassitudine, hyphis 1–1.5 μ diametro reticulatim dispositis, circum algas densius; stratum basale non evolutum.

Apothecia 0.2 × 0.5 mm. aut ad 0.5 mm. diametro, irregulariter elliptica vel circularia, plus minusve applanata, marginata, sessilia, conferte gregaria sparsave, nigra, subnitida; parathecium paucis cellulis in corticem mergens; cortex marginalis bene evolutus, ad 25 μ crassitudine, cellulis magnis isodiametricis carbonaceis; hypothecium 60–70 μ, fusco-brunneum, ad margines tenuescens, pseudoparenchyma-

ticum cellulis pachydermaticis; thecium 50–90 μ altitudine; paraphyses 1 μ, capitibus ad 3 μ, obscuris, non incrustatis, non ramosi vel ad apices ramosi, epithecium 8–12 μ, carbonaceum, asperum, KOH addito virescens; asci (37–)52–60 × 9–11 μ, elongato-clavati, non abrupte inflati ut in *Lecidea cancriformi;* ascosporae 6.5–8.5 × 2–2.5 μ, ellipsoideae, apicibus rotundatis.

Non-assimilative portion represented by a few black strands composed of dark, irregular hyphae, not distinguished morphologically into cortex and medulla, dendritic, extending over areas 4–5 mm. in diameter; assimilative portion up to 0.75 mm., irregularly areolate, soft to gelified when moist, pale olive buff to citrine drab; cortex 10–18 μ thick, of several layers of small fastigiate cells, light to dark brown in the outer layers, the whole covered by a layer of dead cells, amorphous, up to 20 μ thick; algal layer 80–100 μ thick, cells up to 15 μ in diameter, abundant and closely packed; medulla up to 850 μ thick, of slender hyphae 1–1.5 μ in diameter reticulately arranged, more compactly about the algae; lower cortex absent.

Apothecia 0.2 × 0.5 mm. or up to 0.5 mm. in diameter, irregularly elliptical to circular in outline, more or less flattened with a distinct margin, sessile, closely crowded or scattered, black, somewhat shining; parathecium consisting of a few cells merging with the marginal cortex which is well developed, up to 25 μ thick, of large isodiametric cells, carbonaceous, fusing with the epithecium above and the thalline cortex below; hypothecium 60–70 μ, fuscous brown, slightly tapering from the center to the margin, of thick-walled pseudoparenchyma; thecium 50–90 μ tall; paraphyses 1 μ, heads up to 3 μ, darkened, without incrustations, unbranched or branched near the apex, epithecium 8–12 μ thick, carbonaceous, rough, turning green with KOH; asci (37–)52–60 × 9–11 μ, 8-spored, long, slender-clavate, expanding gradually from the attenuate base and not abruptly as in *Lecidea cancriformis;* ascospores 6.5–8.5 × 2–2.5 μ, ellipsoidal, slender, with rounded ends.

On fine-grained gray and pinkish granite.

South Victoria Land: Queen Maud Mts., Durham Point, northeast portal Thorne Glacier, *Q. A. Blackburn, R. S. Russell Jr., S. D. L. Paine QM-4 (83);* Scudder Mt., 86° 03′ S., 150° 40′ W., *Q. A. Blackburn, R. S. Russell Jr., S. D. L. Paine QM-6 (1), (2),* type, *(3), (4).*

LECIDEA **Painei** Dodge & Baker, sp. nov. Pl. 41, figs. 57–62.

Type: South Victoria Land, Queen Maud Mts., Scudder Mt. (B), Station 9, 86° 03′ S., 150° 40′ W., *Q. A. Blackburn, R. S. Russell Jr. & S. D. L. Paine QM-2.*

Thallus ad 2 mm. diametro, irregularis, plus minusve areolatus, arachnoideus vel compactior, mollis gelifactusque madefactus, griseo-albidus; cortex ad 12 μ, fastigiatus, cellulis terminalibus hypharum medullae inflatis obscurisque, ad 4 μ diametro, non continuus, superficie strato irregulari cellularum emortuarum 25–30 μ crassitudine tectus; algae sub cortice coloniis parvis sparsis, cellulis ad 8 μ diametro; medulla hyphis 1–3 μ diametro, in funiculis compactis magnis laxe reticulatimque dispositis; cortex inferior deest aut paucis cellulis obscuris fastigiatis ut in cortice superiori.

Apothecia ad 0.27 mm., parva, irregulariter circularia, emarginata, convexa, sparsa vel gregaria, sessilia, nigra, carbonacea; cortex marginalis ad 35 μ, carbonaceus, pseudoparenchymaticus, cellulis pachydermaticis apice in epithecio mergens; hypothecium ad 20 μ, griseum vel fuscum, cellulis parvis, irregulariter pseudoparenchymaticis ad margines, subtenuescens; thecium ad 50 μ altitudine; paraphyses 0.75–1.0 μ diametro, recti neque inflati neque obscuri, non ramosi aut raro ramosi, tenuiter vaginati, epithecium 5–10 μ, irregulare, carbonaceum, KOH addito virescens; asci 23–31 × 6–9 μ, breves, obtuse clavati, apicibus vaginatis; ascosporae octonae, 6–6.5 × 3.5–5 μ, ovoideae vel breviter ellipsoideae, hyalinae, vaginatae.

Thallus up to 2 mm. in diameter, irregular, more or less areolate, arachnoid to more compact, soft and gelified when moist, dull grayish-white; upper cortex as much as 12 μ thick, of the enlarged and darkened terminal cells of the medulla, fastigiately arranged, not continuous as in *Lecidea cancriformis* and *L. Blackburni*, but of larger cells up to 4 μ in diameter, usually not more than a few cells thick, the whole covered by a more or less irregular layer of dead cells 25–30 μ thick at its best development; algae in scattered colonies below the cortex, cells up to 8 μ; medulla extensive, of slender hyphae 1–3 μ in diameter, closely packed in large, loose reticulate strands; lower cortex lacking or occasionally represented by scattered dark fastigiate cells as in the upper cortex.

Apothecia up to 0.27 mm., small, irregularly circular, emarginate, convex, numerous, scattered or closely grouped, sessile on the thallus, black, carbonaceous; marginal cortex up to 35 μ thick, carbonaceous, of thick-walled pseudoparenchyma, merging at the top with the epithecium, below thinning out and finally disappearing; hypothecium about 20 μ, grayish to fus-

cous, of small irregularly pseudoparenchymatous cells, tapering slightly; thecium up to 50 μ tall; paraphyses 0.75 to 1 μ in diameter, straight, tips neither expanded nor darkened, unbranched, rarely branched, with a narrow sheath, epithecium 5–10 μ thick, irregular, carbonaceous, turning green with KOH; asci 23–31 × 6–9 μ, 8-spored, short, bluntly clavate with a fairly prominent gelified sheath over the top; ascospores 6–6.5 × 3.5–5 μ, hyaline, short-ellipsoid or ovoid with a conspicuous hyaline sheath.

On granitic sandy loam.

SOUTH VICTORIA LAND: Queen Maud Mts., Scudder Mt. (B), Station 9, 86° 03′ S., 150° 40′ W., *Q. A. Blackburn, R. S. Russell Jr. & S. D. L. Paine QM-2*, type.

CATILLARIA

CATILLARIA Massalongo, Richerche Auton. Lich. 78. 1852.

The type species is *C. chalybeia* (Borrer) Mass. (*C. lutosa* (Mont.) Mass.). Originally included in the genus, it was reduced to synonymy with *C. Philippaea* by Massalongo in 1856. *C concreta* Mass. belongs in *Rhizocarpon.*

Thallus crustose, endo- or epilithic, simple or with effigurate margins, attached to the substrate by the hyphae of the prothallus and the medulla, not corticate; algae *Protococcus* (cells in colonies suggesting *Gloeocapsa* in some species of sect. *Biatorina)*. Apothecia circular, immersed to sessile, with hyaline, colored, or black parathecium, without amphithecium, epithecium concave or convex, light or dark-colored; hypothecium hyaline, colored or black; paraphyses not or sometimes branched, tips capitate, free or immersed in a gel; asci 8-spored; spores usually small (under 30 μ), hyaline, ovoid, ellipsoid, or elongate and bacilliform, straight or curved, finally 2-celled with thin wall and thin septum, without a sheath. Spermogonia ellipsoidal to flask-shaped, spermatia straight or slightly curved.

The genus is usually divided into two sections: *Biatorina*, with hyaline or colored parathecium and hypothecium; and *Eucatillaria*, with carbonaceous parathecium and hypothecium. These sections were originally described as genera by Massalongo and are frequently so considered. Of our five

Antarctic species here reported for the first time, two belong in *Biatorina,* and three in *Eucatillaria.*

KEY TO ANTARCTIC SPECIES

Hypothecium dark brown to black; asci under 50 μ; spores under 15 μ long.... ....EUCATILLARIA

Paraphyses capitate with a smooth dark cap; thallus small, arachnoid to areolate, gelified...*C. cremea*

Paraphyses with slightly expanded hyaline tips 2 μ long; thallus granulose, not gelified..*C. granulosa*

Paraphyses not capitate, highly gelified; thallus large, floccose to calcareous when dry, gelified when moist.......................................*C. floccosa*

Hypothecium hyaline or very light brown; asci over 54 μ; spores over 15 μ long; paraphyses capitate...BIATORINA

Paraphyses with conspicuous gelified sheath; thallus scant, grayish over a conspicuous reticulate hypothallus; thecium 80–90 μ, epithecium dark ....*C. inconspicua*

Paraphyses with slightly gelified sheath; thallus abundant, indeterminate, somewhat arachnoid, cream-colored; hypothallus not developed; thecium 50–60 μ tall, epithecium light.......................................*C. arachnoidea*

CATILLARIA **cremea** Dodge & Baker, sp. nov.

Pl. 42, figs. 68–71.

Type: Marie Byrd Land, Edsel Ford Range, Skua Gull Peak, *P. Siple & S. Corey 72W-8.*

Thallus ad 1 cm. diametro, arachnoideus vel areolatus et diffractus, gelifactus madefactus, albidus vel cremeus, saepe ab ochra saxorum tinctus, saxicola; cortex male evolutus, in marginibus rimisque areolarum paucis cellulis obscurioribus fastigiatis munitus, super algas amorphus; stratum gonidiale 65 μ crassitudine, cellulis ad 7 μ in coloniis sphericis, protococcoideis; medulla hyphis laxe reticulatis contexta; stratum basale 50–75 μ, cellulis compactioribus, brunneis obscurius, irregulariter dispositis, non fastigiatis.

Apothecia ad 0.35 mm. diametro, irregularia, applanata, sparsa, emarginata, raro subconcava, sessilia, nigra; parathecium ad 50 μ crassitudine, nigrum, carbonaceum, hypothecio mergens; hypothecium ad 75 μ crassitudine, obscure brunneum vel carbonaceum; thecium circa 50 μ crassitudine; paraphyses 0.75–1.0 μ, capitibus 1.5–2.5 μ, non ramosi, subflexuosi, graciles, epithecium circa 10 μ, obscurum; asci 31–37 × 12–15 μ, late clavati, vagina prominente; sporae octonae, 11–14 × 3–4 μ, uniseptatae, longae, ellipsoideae, apicibus frequenter truncatis.

Assimilative thallus thinly diffused over 1 cm., slightly arachnoid to areolate and fairly deeply cracked, gelified when moist, white to cream, often rusty and discolored from the sub-

strate; cortex poorly developed, sometimes with a few darker fastigiate cells appearing in the cracks and on the sides of the areolae, amorphous over the tops of the areolae; algal layer 65 μ thick, cells protococcoid, up to 7 μ in diameter, in more or less spherical colonies; medulla simple, of loosely reticulate strands; basal cortex 50–75 μ, of more compact cells, darker brown, irregularly arranged, not fastigiate.

Apothecia up to 0.35 mm. in diameter, irregular in outline, flattened, scattered, emarginate, sometimes slightly concave, sessile on the areolae, black; parathecium up to 50 μ thick, black, carbonaceous, merging with the hypothecium which is up to 75 μ thick, light to dark brown and carbonaceous; thecium about 50 μ thick; paraphyses 0.75–1.0 μ, expanding to 1.5–2.5 μ at the heads, even, smooth on the outer surfaces of the heads with a dark cap, mostly unbranched, somewhat flexuous, slender, epithecium about 10 μ, dark; asci 31–37 × 12–15 μ, short, broadly clavate, especially when mature, sheath rather prominent, 8-spored; ascospores fasciculate (vertically aligned at maturity), 11–14 × 3–4 μ, uniseptate, long, slender-ellipsoidal, sometimes with truncate ends.

On dark greenish gray slate.

MARIE BYRD LAND: Edsel Ford Range, Skua Gull Peak, *P. Siple & S. Corey 72W-8*, type.

CATILLARIA **floccosa** Dodge & Baker, sp. nov.

Pl. 42, figs. 63–67.

Type: Marie Byrd Land, Edsel Ford Range, Skua Gull Peak, *P. Siple & S. Corey 72W-2.*

Thallus bene evolutus, floccosus vel calcareus siccatus, gelifactus pustularisque madefactus, albidus vel viridescens; cortex male evolutus, catervis sparsis cellularum obscurarum fastigiatarum; stratum gonidiale circa 150 μ crassitudine, coloniis dispersis, cellulis 6–7 μ diametro; medulla ad 300 μ crassitudine, hyphis tenuissimis reticulatim dispositis, compactioribus ad algas; stratum basale 15 μ crassitudine, simile cortici. Cephalodia cum algis nostocaceis sub strato basali abundanter dispersa.

Apothecia ad 0.35 mm., frequenter circa 0.20 mm., sessilia, irregularia, convexa, in columnis thalli, sparsa, nigra, nitida; parathecium 10–12 μ crassitudine, nigrum; hypothecium ad 20 μ, cellulis nigris, plus minusve reticulatim dispositis; thecium 50–70 μ crassitudine; paraphyses 1.5–2 μ diametro, cellulis brevibus crassis brun-

neis gelifactis, apicibus vix inflatis, epithecium 4–5 μ, obscurum; asci 29–48 × 12–16 μ, elongati, apicibus vaginatis; sporae octonae, 11.5–15 × 3.5–6.5 μ, uniseptatae, non constrictae, alia cellula obtusa vel obtusior quam altera, acuta.

Assimilative portions of thallus well developed, on rock or among loose gravel and mosses, covering areas of several centimeters, floccose to calcareous when dry, gelified and pustular when moist, white to greenish from an abundance of included algae; cortex evanescent, represented by groups of dark fastigiate cells variable in size, scattered here and there over individual pustules; algal layer about 150 μ thick, of scattered colonies, cells 6–7 μ in diameter; medulla up to 300 μ thick, of very delicate hyphae in a loose net, mostly exposed at the surface, better developed and more compact about the colonies of algae; basal layer identical, with scattered dark cortical cells but continuous, about 15 μ thick. Cephalodia with *Nostoc* abundant on the under-side of the basal layer.

Apothecia up to 0.35 mm. in diameter, usually about 0.20 mm., sessile, capping the pillars of the assimilative portions, irregular, convex, scattered and irregular in distribution, black, shining; parathecium 10–12 μ thick, black; hypothecium up to 20 μ, not much diminished laterally, merging with the parathecium, of dark compact cells more or less reticulately arranged; thecium 50–70 μ thick; paraphyses 1.5–2 μ in diameter, of short thick brownish cells, not very distinct as they are highly gelified, tips scarcely inflated, epithecium 4–5 μ, dark; asci 29–48 × 12–16 μ, 8-spored, elongate, the apex pointed, covered with a fairly prominent sheath; spores 11.5–15 × 3.5–6.5 μ, uniseptate, not constricted, one cell usually blunt or blunter than the other which is either distinctly pointed or tapering.

On loose sandy loam from coarse-grained gray granite, granodiorite, and fine-grained dike.

KING EDWARD VII LAND: Rockefeller Mts., Mt. Helen Washington, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff HW-7.*

MARIE BYRD LAND: Edsel Ford Range, Skua Gull Peak, *P. Siple & S. Corey 72W-2*, type, *72W-14;* Lichen Peak, *P. Siple & S. Corey 73-3, 73-4, 73-7;* Chester Mts., *P. Siple & S. Corey 97A-1, 97A-2;* Mt. Rea-Cooper, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff R-4, R-6, R-2 (sterile);* Mt. Donald Woodward, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff DW-1.*

CATILLARIA **granulosa** Dodge & Baker, sp. nov.

Pl. 43, figs. 78–83.

Type: King Edward VII Land, Rockefeller Mts., Mt. Helen Washington, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff HW-10.*

Thallus ad 11 mm. diametro; areolae assimilantes 0.05–0.15 mm. diametro, granulosae, parvae, numerosae, albidae vel ravae, ecorticatae; algae protococcoideae, ad 8 μ diametro, rarissimae, in toto thallo sparsae; medulla hyphis obscure brunneis fuscisve, irregulariter sparsis, amorpha, coloniis bacteriorum interspersis.

Apothecia 0.1–0.33 mm. diametro, plerumque parva, singula vel caespitosa, fusca nigrave, subconcava, excipulo tenuissimo; amphithecium deest; parathecium 25–40 μ crassitudine, cellulis pachydermaticis fuscis isodiametricis, basaliter tenuescens; hypothecium 10–20 μ crassitudine, fuscum, plectenchymaticum; thecium 50–60 μ altitudine; paraphyses 1 μ diametro, apicibus ad 2 μ, hyalini, epithecium 10–20 μ, brunneum, gelifactum; asci 40–44 × (12–)15–18 μ, late clavati insuper, basaliter constricti; ascosporae 11–12 × 5–6 μ, ellipsoideae, una ex cellulis majore, ovoidea, hyalinae.

Thallus over areas up to 11 mm. in diameter; non-assimilative portion absent, assimilative areolae 0.05–0.15 mm., granular to pustular, small, numerous, whitish to drab; cortex lacking; algae protococcoid, up to 8 μ in diameter, very rare, and irregularly scattered throughout the thallus; medulla amorphous with dark brown hyphae irregularly distributed; frequently with large clumps of bacteria within the interstices.

Apothecia 0.1–0.33 mm. in diameter, mostly small, slightly concave with a faint exciple; amphithecium absent; parathecium 25–40 μ thick, well developed, of thick-walled isodiametric cells up to 3 μ forming a compact tissue, tapering below and disappearing in the region of the hypothecium; hypothecium 10–20 μ thick, dark, of closely woven hyphae somewhat fimbriate; thecium 50–60 μ tall; paraphyses 1 μ, slightly expanding above, reaching 2 μ at the tips, not darkened, epithecium 10–20 μ, brown, gelified; asci 40–44 × (12–) 15–18 μ, very broad-clavate above and constricted below, 8-spored; ascospores 11–12 × 5–6 μ, hyaline, ellipsoidal, becoming 2-celled, each cell uninucleate, one cell usually somewhat exceeding the other and more ovoid.

On weathered coarse-grained reddish brown granite.

KING EDWARD VII LAND: Rockefeller Mts., Mt. Helen Washington, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff HW-10*, type.

CATILLARIA **inconspicua** Dodge & Baker, sp. nov.
Pl. 43, figs. 84–87.

Type: Marie Byrd Land, Edsel Ford Range, Chester Mts., *P. Siple & S. Corey 97A-1.*

Thallus non assimilans niger, inconspicuus, reticulis parvis; cortex hyphis magnis obscuris, ramis per omnia irregulariter percurrentibus; medulla hyphis hyalinis tenuioribus reticulatim dispositis vel compactioribus; partes assimilantes griseae, paucae in areas 1 cm. diametro dispersae; cortex prominens, cellulis parvis fastigiatis paullo obscuris; stratum gonidiale 55–60 μ crassitudine, cellulis singulis, binis vel in coloniis parvis plus minusve verticaliter dispositis; medulla hyphis tenuibus ad corticem dendritice ramosis; stratum basale non bene evolutum, cellulis magnis obscuris fastigiatis.

Apothecia ad 1.35 mm. diametro, sessilia in areolis assimilantibus, pulvinata, convexa, irregularia, nigra, carbonacea, sparsa; cortex non evolutus; hypothecium 20–25 μ, hyalinum, hyphis parvis periclinalibus; thecium 80–90 μ altitudine; paraphyses circa 1 μ diametro, capitibus ad 4.5 μ, subobscuris, vaginatis, ramosi vel non ramosi, subflexui, epithecium ad 10 μ crassitudine, obscurum, addito KOH purpurascens; asci 56–67 × 14–16 μ, elongati, clavati, vaginati; sporae octonae, 15–19 × 4.5–7 μ, uniseptatae, elongatae, ellipsoideae, raro reniformes vel naviculares, non constrictae.

Non-assimilative portions of the thallus finely reticulate, black, very inconspicuous against the rock, of coarse dark hyphae forming the cortex and ramifying irregularly throughout the whole thallus; medulla of more slender hyaline hyphae forming fine reticulations, becoming more compact in places; assimilative portions scant over areas of 1 cm., grayish; cortex prominent, of small fastigiate cells little darkened; algal layer 55–60 μ thick, cells single, in pairs or small colonies more or less vertically arranged; medulla of slender loose cells branching in the subcortical region; basal layer not sharply differentiated, often confluent with the non-assimilative parts which form the base in such cases, of large dark fastigiate cells, occasionally occurring laterally in scattered areas.

Apothecia up to 1.35 mm., sessile on the assimilative areolae, pulvinate, convex, irregular in outline, black, carbonaceous, scattered; cortex not differentiated; parathecium of a few hypothecial cells merging with the cortex of the assimilative parts and the epithecium; hypothecium 20–25 μ thick, hyaline, scarcely diminishing in thickness from the center to the margin, of slender periclinal hyphae very compactly woven;

thecium 80–90 μ tall; paraphyses about 1 μ in diameter, heads 4.5 μ, slightly darkened, sheath rather conspicuous, branched or unbranched, slightly flexuous, epithecium about 10 μ thick, dark, turning purple on the addition of KOH; asci 56–67 × 14–16 μ, quite elongate, clavate with a sheath, 8-spored; spores 15–19 × 4.5–7 μ, uniseptate, elongate-ellipsoidal, rarely reniform or navicular, not constricted at the septum.

The systematic position of *C. inconspicua* is uncertain. The apothecium rests on an assimilative areola no larger than the apothecium. If the assimilative tissue is regarded as an amphithecium, this species belongs in *Lecania* near *L. Racovitzae* but clearly is not that species, while if it is regarded as thallus, it belongs in *Catillaria.*

On coarse-grained gray granite.

MARIE BYRD LAND: Edsel Ford Range, Chester Mts., *P. Siple & S. Corey 97A-1*, type; Mt. Rea-Cooper, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff R-7 (1).*

CATILLARIA **arachnoidea** Dodge & Baker, sp. nov.

Pl. 42, figs. 72–77; pl. 65, fig. 428.

Type: Marie Byrd Land, Edsel Ford Range, Mt. Rea-Cooper, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff R-7(1).*

Thallus appressus, saxicola, conspicuus, indeterminatus, verrucosus, areolis ad 0.45 mm., irregularibus, angularibus, plus minusve arachnoideus, albidus vel cremeus; cortex evanescens, in marginibus areolarum, cellulis fastigiatis obscuris persistentibus; stratum gonidiale 85–90 μ crassitudine, cellulis coloniisque subverticaliter dispositis; medulla 220 μ crassitudine, hyphis 2–3 μ diametro, ramosis anastomosantibusque laxe implexis, compactior sub strato gonidiale apotheciisque, hyphis 1 μ diametro; stratum basale obscurum compactiusque.

Apothecia ad 0.33 mm. diametro, hemispherica vel irregularia, saepe angulata, plana vel convexa, emarginata, sparsa vel gregaria, sessilia, obscure brunnea vel nigra; cortex cellulis magnis nigris, 11–12 μ crassitudine; parathecium circa 20 μ crassitudine, cellulis obscure brunneis isodiametricis in cortice mergens; hypothecium ad 10 μ crassitudine, non prominens, hyalinum vel dilute brunneum, cellulis reticulatim dispositis; thecium 50–70 μ altitudine; paraphyses 1.5 μ diametro, capitibus 2.5 μ, non obscuris, gelifacti, ramosi vel non ramosi, epithecium 5–8 μ, non obscurum; asci 54–60 × 14–16 μ, elongato-clavati, vagina non prominente; ascosporae octonae, 15–18 × 4–6 μ, 1–2-septatae, non constrictae, elongatae, ellipsoideae, raro subreniformes vel naviculares.

Assimilative portion of thallus closely attached to rock, conspicuous and well developed, indeterminate, verrucose, areolae

up to 0.45 mm. long, irregular, angular, more or less arachnoid, white to cream-colored; cortex not well developed, occurring in scattered places on lateral margins of the areolae, of dark fastigiate cells, evanescent over the rest, leaving tissue similar to the medulla above the algal layer which is 85–90 μ thick with cells and colonies somewhat vertically arranged; medulla 220 μ thick, of open reticulate tissue, hyphae branched and anastomosed, 2–3 μ in diameter, slightly more compact about the algae and below the apothecia, hyphae about 1 μ in diameter; basal layer sometimes darker, and a little more compact than the medulla but not sharply differentiated from it.

Apothecia up to 0.33 mm. in diameter, hemispherical to irregular, often angled by mutual pressure when close together, plane or convex, sometimes with a slight depression when young but never distinctly margined, scattered or gregarious, sessile, dark brownish to black; cortex 11–12 μ thick, of large black cells; parathecium 20 μ thick, of dark brown, isodiametric cells merging with the cortex and becoming progressively thin-walled toward the thecium; hypothecium up to 10 μ thick, not prominent, hyaline or light brown, of reticulately arranged cells, not thinning conspicuously toward the margin; thecium 50–70 μ thick; paraphyses 1.5 μ, expanding slightly at the apices up to 2.5 μ in diameter, heads not darkened, with a close gelified sheath, branched or unbranched, epithecium 5–8 μ, light; asci 54–60 × 14–16 μ, elongate-clavate, sheath not prominent, 8-spored; ascospores 15–18 × 4–6 μ, becoming 1–2-septate, not constricted at the septa, elongate-ellipsoidal, occasionally somewhat reniform or even navicular.

On coarse-grained gray granite.

MARIE BYRD LAND: Edsel Ford Range, Mt. Rea-Cooper, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff R(26–27)-7, R-7(1)*, type.

RHIZOCARPON

RHIZOCARPON Ram. ap. Lamarck & DeCandolle, Fl. Franç. ed. 3. 2: 365. 1805.

Abacina Norm., Nyt. Mag. Naturvidensk. 7: 236. 1853.

Siegertia Koerber, Parerga Lich. 180. 1861.

Phalodictyum Clements, Gen. Fung. 77. 1909.

The type species is *Rhizocarpon geographicum* (L.) Ram. The type of *Abacina* is not designated but *Abacina amphibia* (Fr.) Norm. may be so considered. The type of *Siegertia* is *Lecidea calcarea* (Weis) Hepp. The type of *Phalodictyum* is *P. obscuratum* (Ach.) Clem.

Thallus crustose, uniform, with well-developed hypothallus; ecorticate; algae *Protococcus*. Apothecia sessile or immersed in the thallus; parathecium carbonaceous, rarely brown; hypothecium dark; thecium gelified, paraphyses branched; asci 1–8-spored; ascospores hyaline or finally brown, 2- or several-celled, becoming muriform by vertical septa, with a well-developed gelified sheath. Spermatia cylindric to acicular, straight or nearly so.

Zahlbruckner recognizes two subgenera which are often recognized as genera.

Catocarpus Koerber, Syst. Lich. Germ. 223. 1855 (as section of *Buellia).*

Catocarpus Arnold, Flora **54**: 147. 1871.

Rehmiopsis Müll. Arg., Flora **55**: 537. 1872 (as section of *Patellaria).*

Catocarpon Th. Fries, Lichenog. Scand. 612. 1874.

Diphaeis Clements, Gen. Fung. 77. 1909.

Diphanis Clements, Gen. Fung. 77. 1909.

The type species of *Catocarpus* Koerb., *Catocarpus* Arn., *Catocarpon* Th. Fr., and *Diphaeis* Clem. is *C. badioatrus* (Flk.) Arn. The type of *Rehmiopsis* is *Patellaria heterodoxa* Müll. Arg. The type of *Diphanis* is *D. polycarpa* (Hepp) Clem.

This subgenus or genus is separated on the basis of its two-celled spores and shows some transition to *Buellia.* Two species have been reported from the Graham Land Archipelago.

Eurhizocarpon Stzbgr. includes species with muriform spores.

KEY TO ANTARCTIC SPECIES

Spores 2-celled...CATOCARPUS

Spores hyaline; thallus brownish or brownish gray, smooth, I blue..*R. polycarpum*

Spores brown; thallus brown, verrucose, I–...........*R. badioatrum* v. *Gerlachei*

Spores muriform...EURHIZOCARPON

Thallus pure white; medulla I– . . . . *R. argyreum*
Thallus yellowish.
Thecium more than 180 μ tall; paraphyses capitate, 4–6 μ.
Thecium 180–200μ; spores 25–43.7 × 16–18 μ; cortex 30–40 μ, with a hyaline zone 15 μ thick . . . . *R. geographicum*
Thecium 240 μ; spores 26–30 × 14–18 μ; cortex 20–30 μ, with a hyaline zone 20 μ . . . . *R. melanostictum*
Thecium 130 μ tall; paraphyses subcapitate, 2–3 μ; spores 27–34 × 12–15 μ; cortex 20–50 μ, with a hyaline zone 10 μ thick . . . . *R. nidificum*
Thecium 70–100 μ; paraphyses not capitate; spores 15–24.5 × 8–11 μ; cortex not differentiated . . . . *R. flavum*
Thallus ashy fuscous.
Ascospores 58–72 μ long, 2 per ascus . . . . *R. geminatum*
Ascospores (20–)33–38 μ long, 8 per ascus; thallus 0.2–0.6 mm. thick . . . . *R. griseolum*
Ascospores 28–30 μ long, 8 per ascus.
Thallus very thin, KC red . . . . *R. parapetraeum*
Thallus thick, verrucose, KC– . . . . *R. grande* v. *atrocaesium*

RHIZOCARPON **flavum** Dodge & Baker, sp. nov.
Pl. 43, figs. 88–93; pl. 44, figs. 94–97; pl. 65, fig. 426.
Type: Marie Byrd Land, Mt. Stancliff, *P. Siple & S. Corey 72A-2.*

Thallus crustosus, appressus, 2.2 cm. diametro vel 3 × 1.5 cm., non assimilans niger, carbonaceus, continuus, margine determinata centro subfuniculoso; areolae elevatae, saepe cellulis emortuis albis tectae; cortex superior 15 μ crassitudine, fastigiatus, cellulis obscure brunneis vel nigris, isodiametricis; medulla 120 μ crassitudine, hyphis hyalinis verticalibus laxissime implicatis; areolae assimilantes ad 1.5 mm. longitudine, 0.45 mm. altitudine, irregulares, saepe sinuosae vel angulares, dein repetito diffractae, pulvinatae, flavae, sine marginibus cellularum corticalium, floccosae; cortex superior non differentiatus; stratum gonidiale ad 140 μ crassitudine, protococcoideum, cellulis 9–16 μ diametro; medulla ad 200 μ, hyphis verticalibus subbrunneis; stratum basale plus minusve pseudoparenchymaticum, brunneum, ad 150 μ crassitudine.

Apothecia ad 0.9 mm. diametro, convexa vel subconcava, marginata, angularia, sparsa vel gregaria, singulariter in columnis nata, nigra, non nitida, juniora cellulis emortuis corticalibus equatorialibus ornata; parathecium non bene evolutum; hypothecium obscurum, hyphis periclinalibus dense compactum, 60–90 μ, ad marginem tenuescens; thecium 70–100 μ altitudine; paraphyses 1.5–3 μ diametro, ramosi vel non ramosi, septati, aetate obscurascens, gelifacti, pachydermatici, apicibus non capitatis, raro obscure callosis, epithecium 8–10 μ crassitudine efficientes; asci 53–80 × 16×30 μ, clavati, vaginati, gelifacti, raro angustiores longioresque, tum sporis monostichis; sporae octonae, (15)–17–24.5 × 8–14 μ, nigerrimae, uniseptatae dein muriformes, raro nonseptatae.

Thallus closely attached to the rock over areas up to 2.2 cm. in diameter or 3 × 1.5 cm.; non-assimilative areas black, carbo-

naceous, usually continuous, margin determinate but often separating into distinct strands toward the center of the fructification; pillars frequently covered with dead white cortical cells giving an areolate or reticulate appearance, sometimes especially pronounced in a zone just back of the pure black margin; upper cortex 15 μ thick, fastigiate, forming a pseudoparenchyma of dark brown or black cells; medulla 120 μ thick, of vertical hyphae loosely woven; assimilative areolae up to 1.5 mm. long and 0.45 mm. high, irregular in outline, often sinuous or angular, further separated by secondary cracks, usually very pulvinate, chartreuse yellow, not bordered with black cortical cells or only very slightly so, floccose; upper cortex evanescent or not differentiated, but cells slightly more compact; algal layer up to 140 μ thick, protococcoid, cells 9–16 μ in diameter; medulla up to 200 μ thick, of vertical hyphae rather loosely arranged, brownish basal layer more or less pseudoparenchymatous from periclinal brown hyphae, up to 150 μ thick.

Apothecia up to 0.9 mm. in diameter, convex or slightly concave with a marginal rim, frequently angled, scattered or gregarious, borne singly on the pillars, sessile or subsessile, dull black, never shiny, when young with an equatorial fringe of dead cortical cells; parathecium scarcely distinguishable except as a few cells, more closely united, extending in a thin line from the hypothecium to the exciple; hypothecium dark, of closely united periclinal hyphae, 60–90 μ, thinning toward the margin; thecium 70–100 μ tall; paraphyses 1.5–3 μ in diameter, branched or unbranched, septate, apparently becoming darker with age, with conspicuous gelified sheaths, heavy walls, not or only slightly expanded at the tips, occasionally with a dark cap, forming an epithecium 8–10 μ thick; asci 53–80 × 16–30 μ, large, bluntly clavate, 8-spored, with a moderately conspicuous gelified sheath, sometimes narrow and elongate with spores practically monostichous; ascospores (15)–17–24.5 × 8–14 μ, very dark, at first uniseptate, later muriform, sometimes remaining undivided.

On weathered biotite-sericite, sericite-orthoclase schist, and fine-grained dike.

MARIE BYRD LAND: Edsel Ford Range, Mt. Donald Woodward, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff DW-3, DW-4, DW-5;* Lichen Peak, *P. Siple & S. Corey 73-10;* Mt. Stancliff, *P. Siple & S. Corey 72A-1, 72A-2,* type.

ACAROSPORACEAE

Thallus little developed, crustose, squamulose or dwarf foliose, homoeomerous or heteromerous, attached to the substrate by the hyphae of the medulla or the prothallus or by a central strand in *Glypholechia,* without rhizinae; ecorticate or more or less corticate; with *Protococcus* algae. Apothecia immersed in thalline warts, sometimes nearly perithecioid, sessile or short-stipitate, single or crowded, with a circular or somewhat irregular disc, biatorine, lecideine, or lecanorine; asci polysporous; ascospores very small, usually unicellular, two-celled in *Maronea,* with thin walls and without sheaths.

Only *Acarospora,* thallus small, squamulose with small-celled pseudoparenchymatous cortex, apothecia immersed without a well-developed parathecium, has previously been found in Antarctica.

KEY TO ANTARCTIC GENERA

Parathecium highly developed.
  Apothecia biatorine with soft bright parathecium; epi- or endophloedal, saxicolous in Antarctica..*Biatorella*
  Apothecia lecideine with carbonaceous parathecium.
    Apothecia immersed; thallus well developed; epilithic, Arctic, alpine..*Sporostatia*
    Apothecia sessile or short-stalked; thallus poorly developed.........*Sarcogyne*
Parathecium absent..*Acarospora*

BIATORELLA

BIATORELLA DeNotaris, Giorn. Bot. Ital. II. 1[1]: 192. 1846.
Myrioblastus Trevisan, Linnaea **28**: 289. 1856.
Strangospora Koerber, Parerga Lich. 173. 1860.
Biatoridium Lahm. ap. Koerber, Parerga Lich. 172. 1860.

The type species is *Biatorella Roussellii* (Durieu & Montagne) DeNotaris. The type of *Myrioblastus* is *Lecidea fossarum* Dufour. The type of *Biatoridium* is *B. monasteriense* Lahm. The type of *Strangospora* is *S. pinicola* Koerber.

Thallus epi- or hypophloedal, or epilithic, crustose, uniform

or effigurate, attached to the substrate by hyphae of the prothallus or medulla; cortex absent or of irregularly woven hyphae; algae *Protococcus,* and arachnoid medulla. Apothecia circular, rarely irregular, immersed, sessile or very short-stalked, single; parathecium well developed above, absent below, disc smooth, verrucose or folded; hypothecium bright or dark; paraphyses slender, filiform, simple or seldom branched, persistent or evanescent; asci more or less clavate, polysporous; ascospores hyaline, unicellular, ellipsoidal or spherical, small, with a thin wall. Spermogonia immersed in the thallus or in thalline warts; spermatia ovoid or short-cylindric.

BIATORELLA **arachnoidea** Dodge & Baker, sp. nov.

Pl. 46, figs. 139–141.

Type: Marie Byrd Land, Edsel Ford Range, Skua Gull Peak, *P. Siple & S. Corey 72W-14.*

Thallus assimilans, 0.19–0.85 mm., arachnoideus, sparsus, ferrugineo-albus; algis ad 12 μ diametro, protococcoideis.

Apothecia 0.28–0.75 mm. diametro, parva, marginibus incurvis juventute, concava maturitate, pallido-flava; hypothecium hyalinum; thecium 35–40 μ altitudine; paraphyses 0.5–1.2 μ diametro, aequales, liberi, flexui, ramosi, frequenter sub apicibus bifurcati, non obscuri, cellulis longis, tenuibus, epithecium 10–15 μ, hyalinum; asci 34–40 × 20–21 μ, breves, late clavati, polyspori (30–50 per ascum), basi sine sporis; ascosporae 6–7.5 × 3–4 μ, ellipsoideae, apicibus obtusis vel subacutis, vaginatae.

All portions of the thallus assimilative, 0.19–0.85 mm., arachnoid, scattered, rusty white; algae up to 12 μ in diameter, protococcoid.

Apothecia 0.28–0.75 mm. in diameter, mostly small, with an inrolled margin when young, remaining more or less concave at maturity, pale yellowish; hypothecium hyaline; thecium 35–40 μ tall; paraphyses 0.5–1.2 μ in diameter, scarcely expanded at the tips, somewhat free and flexuous, branched, frequently bifurcate near the tip, not darkened on the outer surfaces, cells long, slender, epithecium 10–15 μ, hyaline; asci 34–40 × 20–21 μ, short and very broadly clavate with a small sheath, polysporous (30–50 per ascus), basal portion free from spores; ascospores 6–7.5 × 3–4 μ, ellipsoidal, ends blunt or somewhat pointed with a distinct halo.

On fine-grained dike in sedimentary rock.

Material of this species was very scant; only two apothecia were seen, of which one was mounted for study.

MARIE BYRD LAND: Edsel Ford Range, Skua Gull Peak, *P. Siple & S. Corey 72W-14.*

SARCOGYNE

SARCOGYNE Flotow, Bot. Zeit. **9**: 753, 759. 1851.

Stereopeltis Franz. & DeNotaris, Comm. Soc. Crittogamol. Ital. **1**[1]: 26. 1861.

Pleolecis Clements, Gen. Fung. 76. 1909.

The type species is *S. corrugata* Flotow. The type species of *Stereopeltis* is *S. macrocarpa* Franz. & DeNotaris. The type species of *Pleolecis* is *Lecidea geophana* Nyl.

Thallus poorly developed, epilithic, crustose; often ecorticate or with a poorly developed fastigiate cortex; algae *Protococcus;* medulla loosely woven without lower cortex. Apothecia sessile or short-stipitate, often somewhat elongate or angled, lecideine with a carbonaceous parathecium; hypothecium hyaline or brown; paraphyses slender, sometimes branched, gelified; asci polysporous; ascospores simple, ellipsoidal to spherical, small, thin-walled.

This genus is often considered a subgenus of *Biatorella,* from which it differs in its poorly developed, epilithic thallus and its lecideine, more or less angled, substipitate apothecia with highly developed parathecium. The thallus is often reduced to a small areole at the base of the apothecium.

No species have previously been reported from the Antarctic.

SARCOGYNE **angulosa** Dodge & Baker, sp. nov.

Pl. 46, figs. 127–132.

Type: Marie Byrd Land, Edsel Ford Range, Chester Mts., *P. Siple & S. Corey 97A-3.*

Thallus assimilans ad 0.09 mm. diametro, arachnoideus, delicatus, cremeus; cortex rarus, cellulis fastigiatis obscure brunneis fuscisve, superficie zona crystallorum ($CaCO_3$) 10–15 μ crassitudine; stratum gonidiale sparsum, cellulis protococcoideis ad 8 μ diametro; medulla ad 180 μ crassitudine, hyphis magnis irregu-

laribus leptodermaticis, ad 4 μ diametro, laxe subverticaliter dispositis; cortex inferus non evolutus.

Apothecia 0.08–0.4 mm. diametro, irregularia, ellipsoidea vel plus minusve rectangularia, marginata, sparsa caespitosave angulataque, nigra, nitida exsiccatione, margine nigra, disco rubro-brunneo madida; parathecium 10–30 μ crassitudine, basaliter tenuescens, paucis cellulis obscure fuscis isodiametricis, 2–3 × 10–13 μ, pachydermaticis; hypothecium ad 20 μ crassitudine, hyalinum, cellulis compactioribus; thecium 60–80 μ altitudine; paraphyses 0.5–1.0 μ diametro, apicibus ad 4 μ diametro, flexuosi, ramosi, obscuri, epithecium 10–15 μ, gelifactum carbonaceumve; asci 64–81 × 15–24 μ, polyspori, late clavati insuper, subtus tenuescentes, sporis tote impleti; ascosporae 2.2–3.5 ×1.1–2.0 μ, ovoideae, halone inconspicuo.

Non-assimilative portion absent; assimilative portions up to 0.09 mm. in diameter, arachnoid, scantily spread over the rock, very delicate and limited to the basal portions of the apothecia, cream-white; cortex scantily represented by occasional groups of dark brown to fuscous fastigiate cells, the outer surface covered more frequently by a zone of crystalline deposits ($CaCO_3$) 10–15 μ thick; algae protococcoid, up to 8 μ in diameter, relatively few in small scattered groups; medulla up to 180 μ thick, of large irregular thin-walled hyphae up to 4 μ in diameter, loosely and more or less vertically arranged; basal cortex not differentiated.

Apothecia 0.08–0.4 mm. in diameter, irregularly circular or elliptic to more or less rectangular with distinct margin, scattered or closely clustered and then angled by mutual pressure, black, shining when dry, the margin black, the disc dull reddish brown when moistened; parathecium 10–30 μ thick, well developed laterally, thinning below to a few dark fuscous isodiametric cells, 2–3 × 10–13 μ, the outermost rows darkened and thick-walled; hypothecium about 20 μ thick, of more compact cells, hyaline, merging laterally into the parathecium; thecium 60–80 μ tall; paraphyses 0.5–1.0 μ in diameter, expanding at the tips to heads up to 4 μ, flexuous, branched, darkened on the outer surfaces, epithecium 10–15 μ, dark, gelified to carbonaceous; asci 64–81 × 15–24 μ, polysporous, broadly clavate above, slender below, entirely filled with spores from tip to base; ascospores 2.2–3.5 × 1.1–2.0 μ, ovoid, with a faint scarcely distinguishable halo.

On highly metamorphosed quartzitic rock.

MARIE BYRD LAND: Edsel Ford Range, Chester Mts., *P. Siple & S. Corey 97A-3*, type.

SARCOGYNE **grisea** Dodge & Baker, sp. nov.

Pl. 46, figs. 133–138.

Type: Marie Byrd Land, Edsel Ford Range, Lichen Peak, *P. Siple & S. Corey 73-1*.

Pars non assimilans funiculis irregularibus nigris; pars assimilans floccis sparsis vel areis compactioribus 2 × 3 mm., albida vel grisea, ecorticata; algae ad 10 μ, protococcoideae, rarae, sparsae; medulla laxe filamentosa; cortex inferior deest.

Apothecia ad 0.45 mm. diametro, irregulariter circularia, concava, marginata, nigra, nitida vel non, sessilia, sparsa, singula aut gregaria coacervataque; parathecium 30– 80 μ crassitudine, pseudoparenchymaticum, fuscum vel dilute brunneum, irregulariter sub thecium 100–200 μ percurrens; thecium circa 100 μ altitudine; paraphyses 1–1.5 μ diametro, graciles, flexuosi, simplices vel ramosi, non capitati, evaginati, non obscuri, epithecium 10–20 μ, hyalinum; asci 58–66 × 21–26 μ, late clavati, sporis impleti, polyspori, vagina 18 μ apice crassitudine; ascosporae 2–2.5 × 0.5–1.5 μ, hyalinae, ovoideae ellipsoideaeve.

Non-assimilative portion confined to a few short irregular black strands below the assimilative portions which range from fragmentary bits to more compact areas 2 × 3 mm., white to grayish, not corticate; algae up to 10 μ, protococcoid, rare, scattered; medulla of loose filamentous hyphae; lower cortex not differentiated.

Apothecia up to 0.45 mm. in diameter, irregularly circular, very concave, marginate, black, shining or dull, sessile, scattered and single or gregarious and heaped; parathecium 30–80 μ thick, pseudoparenchymatous, fuscous to light brown, irregularly extending below the thecium 100–200 μ; thecium about 100 μ tall; paraphyses 1–1.5 μ in diameter, slender, flexuous, branched or not, without a prominent sheath, not much expanded at the tips nor darkened, epithecium 10–20 μ, hyaline; asci 58–66 × 21–26 μ, broadly clavate and completely filled with spores, polysporous, with a conspicuous sheath up to 18 μ thick at the apex; ascospores 2–2.5 × 0.5–1.5 μ, hyaline, ovoid to ellipsoidal.

On erratic pink granite and sericite-orthoclase schist.

MARIE BYRD LAND: Edsel Ford Range, Lichen Peak, *P. Siple & S. Corey 73-1*; Mt. Stancliff, *P. Siple & S. Corey 72A-1*.

Umbilicariaceae

Thallus foliose, mono- or polyphyllous, attached to the substrate by a central strand, heteromerous, under-side often rhizinose, corticate on both surfaces; medulla loose, algae *Protococcus*. Apothecia appressed, sessile or almost stalked; amphithecium rarely present; parathecium carbonaceous, usually well developed, with a loose medulla below, sometimes with a few algae, disc folded, seldom smooth; asci 1–8-spored; spores hyaline or dark, unicellular, several-celled to muriform with a thin wall.

The division of this family into genera and smaller subdivisions presents serious problems. Zahlbruckner recognizes five genera as in the following key. Frey would unite *Gyrophora* and *Umbilicaria*. Scholander would recognize *Umbilicaria* and *Gyrophora* with different characters than those used by Zahlbruckner, and would segregate two others. Since most of our Antarctic material is sterile, we have referred it to *Umbilicaria,* the oldest name in the group, without attempting to reach a decision on the three current classifications of this family. *Charcotia* Hue is endemic in the Antarctic.

The systematic position of *Omphalodium* has long been debated. It is usually placed in the Parmeliaceae on the basis of a lecanorine apothecium. The presence of a lecanorine apothecium in *Charcotia* and *Dermatiscum* of the Umbilicariaceae seems to warrant the inclusion of *Omphalodium* in this family. When sterile, it would be looked for here.

KEY TO ANTARCTIC GENERA (after Zahlbruckner)

Apothecia lecideine.
  Spores unicellular, often brown in age; asci 8-spored .... *Gyrophora*
  Spores muriform, brown; asci 1–2-spored .... *Umbilicaria*
Apothecia lecanorine; asci 8-spored.
  Spores unicellular .... *Omphalodium*
  Spores 2-locular.
    Spores hyaline .... *Charcotia*
    Spores brown .... *Dermatiscum*

UMBILICARIA

Umbilicaria Hoffm., Desc. Adumb. Pl. . . . Lich. 1: 9. 1789.

Two type species were recognized in Hoffmann's first treatment: *U. exasperata* treated by Zahlbruckner as a variety of *Gyrophora proboscidea,* and *U. cirrosa,* both in *Gyrophora* sect. *Eugyrophora.*

Thallus foliose, mono- or polyphyllous, attached to the substrate by a central strand, heteromerous, under-side smooth or hirsute; upper cortex pseudoparenchymatous, commonly covered by a much thinner, amorphous layer; algae protococcoid; medulla arachnoid, lower cortex pseudoparenchymatous, sometimes from a palisade of hyphae with isodiametric cells. Apothecia lecideine, disc smooth or papillate or gyroseplicate; asci 1-, 2-, or 8-spored, ascospores 1-, 2-celled or muriform, hyaline or brown. Spermogonia papillate, immersed, with black tips, spermatiophores branched; spermatia short to cylindric.

KEY TO SPECIES REPORTED FROM THE ANTARCTIC

Without rhizinae below.
  White or pale below, dark above with pale margins; apothecia lecanorine; ascospores unicellular............................*Omphalodium quartum*
  Dark below.
    Areolate-verrucose below; monophyllous..........................*U. rigida*
    Glabrous or rarely white-granular below.
      Polyphyllous; upper cortex 20–40 μ thick, black to ashy with white globules; fuscous below..............................*U. parvula*
      Monophyllous.
        Upper cortex rimulose-areolate, ashy pruinose; below black with pale margins...................................*U. leiocarpa* v. *nana*
        Upper cortex reticulate-rugose.
          Upper cortex 150 μ, with fine rimose areolae, dark gray or brown; below black with paler margins...................*U. decussata*
          Upper cortex 80 μ, black with white hemispheric or flattened warts; below fuscous....................................*U. eximia*
          Upper cortex 10–15 μ, deep olive buff shading to dark olive gray at the margins; below black..........................*U. rugosa*
        Upper cortex cerebriform-rugose, 20 μ, minutely rimose-areolate, between Naples yellow and olive buff, darkening; below light ochraceous buff, darkening..........................*U. cerebriformis*
        Upper cortex smooth, minutely areolate, 20 μ, chamois to olive buff, darkening; below blackening....................*U. pateriformis*
With rhizinae below; monophyllous.
  Pale below; ashy pruinose above with black marginal rhizinae.....*U. cylindrica*
  Fuscous below; ashy pruinose above with tufts of marginal rhizinae..*U. cristata*

Black below.

Upper cortex gray to chocolate brown, rimose-areolate, 30–40 μ thick; apothecia lecideine; spores unicellular, 8–12.5 × 5.3–8 μ........*U. vellea*

Upper cortex bay becoming bay fuscous near the margins, slightly rimulose-areolate....................................*U. Dillenii* v. *solida*

Upper cortex ashy rufidulous, 40–100 μ thick, smooth, very slightly rugulose under lens; apothecia lecanorine; spores 2-celled, 12–14 × 4–5 μ ....*Charcotia rufidula*

Upper cortex mummy brown to light buff, 20–25 μ thick, deeply reticulate-rugose, slightly rimulose-areolate in center, otherwise not cracked; rhizinae not concrescent in trabeculae...................*U. spongiosa*

OMPHALODIUM **quartum** (Darbishire) Dodge & Baker, comb. nov.

Parmelia quarta Darbishire, Nat. Antarct. [Discovery] Exp. Nat. Hist. Lichenes 5: 6. 1910.

UMBILICARIA **rugosa** Dodge & Baker, sp. nov.

Pl. 44, figs. 98–104; pl. 63, figs. 414, 416.

Type: King Edward VII Land, Rockefeller Mts., Mt. Helen Washington, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff HW-12.*

Thallus monophyllus, 8–9 cm. diametro, reticulatim scrobiculosus, centro olivaceo-alutaceus, marginibus obscure olivaceo-griseis, crenulatis, tenuissimis, fragilibus, non laciniatus, subtus niger, minute floccosus vel pruinosus, laevis, sine rhizinis, ad umbilicum non rugosus; cortex superior 10–15 μ crassitudine, cellulis magnis isodiametricis, exteris obscuris, interis hyalinis, strato ad 25 μ crassitudine cellularum emortuarum tectus; stratum gonidiale 20–65 μ crassitudine, cellulis ad 10 μ diametro, protococcoideis; medulla 200–300 μ crassitudine, hyphis 2–4 μ diametro, pachydermaticis, laxe implexis, ramosis anastomosantibusque, cellulis brevibus; cortex inferior ad 40 μ crassitudine, pseudoparenchymaticus, obscurus, sine cellulis emortuis.

Apothecia ad 2 mm. diametro, irregularia, gyrosa, fusca nigrave, non nitida; parathecium ad 25 μ crassitudine, fuscum, cellulis pachydermaticis isodiametricis; medulla hyphis laxe implexis; hypothecium ad 150 μ crassitudine, obscurum, irregulare; thecium 50–80 μ altitudine; paraphyses 1 μ diametro, vaginati, simplices ramosive, septati, capitibus 1.5–2 μ diametro, epithecium 10–13 μ crassitudine, gelifactum, brunneum; asci (37–)39–46 × 11–13.5 μ, late clavati insuper, gracillimi subtus, vagina tenui; ascosporae octonae, 7.5–9 × 3–4 μ, ellipsoideae, apicibus obtusis, hyalinae.

Thallus monophyllous, 8–9 cm. in diameter, upper surface deeply and coarsely reticulate-scrobiculate, folds closer and pits shallower near the margin, center deep olive buff, margins dark olive gray, crenulate, very thin and fragile, not laciniate, below black, dull, appearing minutely cottony or pruinose,

smooth, without rhizinae, not folded at the umbilicus; upper cortex 10–15 μ thick, of large isodiametric cells, very dark on the outside, hyaline within, covered by a layer of dead cells up to 25 μ thick; algal layer 20–65 μ thick, cells up to 10 μ, protococcoid; medulla 200–300 μ thick, of thick-walled hyphae 2–4 μ in diameter with rather short cells loosely interwoven, branched, and anastomosed; lower cortex up to 40 μ thick, pseudoparenchymatous, dark, without a layer of dead cells at the surface.

Apothecia up to 2 mm. in diameter, irregular, gyrose, fuscous to black, dull; parathecium up to 25 μ thick, fuscous, cells isodiametric, thick-walled, continuous laterally with the thalline cortex; medulla of loosely woven hyphae; hypothecium up to 150 μ thick, dark, irregular; thecium 50–80 μ tall; paraphyses 1 μ, expanding to heads 1.5–2 μ in diameter, with a sheath, straight or branched, septate, epithecium 10–13 μ, gelified, brown; asci (37–)39–46 × 11–13.5 μ, clavate above and very slender below, with a thin sheath, 8-spored; ascospores 7.5–9 × 3–4 μ, ellipsoidal, mostly with blunt ends, hyaline.

On orthoclase-sericite-siderite schist, coarse pink granite, fine-grained dike, and weathered dike of porphyritic diabase.

KING EDWARD VII LAND: Rockefeller Mts., Mt. Helen Washington, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff HW-12*, type, *HW-13, HW-14, HW-15*.

MARIE BYRD LAND: Edsel Ford Range, Skua Gull Peak, *P. Siple & S. Corey 72W-13, 72W-14, 72W-15, 72W-16;* Mt. Grace McKinley, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff McK-2, McK-3, McK-6, McK-10.*

UMBILICARIA **cerebriformis** Dodge & Baker, sp. nov.
Pl. 45, figs. 107–110; pl. 63, fig. 412.

Type: Marie Byrd Land, Edsel Ford Range, Skua Gull Peak, *P. Siple & S. Corey 72W-15.*

Thallus monophyllus, ad 2.5 cm. diametro, rugosus cerebriformisque, minute areolatus, marginibus crispatis, elevatis, subpruinosis, flavus neapolitanus aut olivaceo-alutaceus, nigricans, subtus laevis, dilute ochraceo-alutaceus, nigricans, sine rhizinis; cortex superior ad 20 μ crassitudine, subfastigiatus, decompositus pseudoparenchymaticusve, non obscurascens, cellulis 3–4 μ diametro, laxe dispositis, strato gelifacto ad 60 μ crassitudine, fracto tectus; stratum gonidiale 40–50 μ crassitudine, 25–60 μ sub cortice, cellulis protococcoideis, ad 9 μ diametro, in coloniis parvis; medulla frequenter 140–175 μ crassitudine aut ad 400 μ, hyphis 2–4 μ diametro, ramosis anastomosantibusque, verticaliter super algas dispositis, et densius periclin-

alibus in strato 30–40 μ crassitudine ad corticem inferiorem; cortex inferior 30–40 μ crassitudine, pseudoparenchymaticus, obscurus.

Apothecia juvenilia, nigra, sessilia subimmersave; cortex 35 μ, fastigiatus intus cortici thallino similis, hyphis cellulis isodiametricis nigris, 15 μ diametro terminatis; parathecium tenue, hyalinum, hyphis tenuibus dense compactis; hypothecium circa 60 μ crassitudine; thecium circa 60 μ altitudine; paraphyses tenues, 1 μ diametro; asci juveniles clavati, vaginati.

Spermogonia ampulliformia juventute, dein applanata irregulariaque, ostiola parva; murus carbonaceus, niger, cellulis parvis isodiametricis; spermatiophorae flexuosae, tenues, septatae; spermatia bacilliformia, recta, brevia.

Thallus monophyllous, up to 2.5 cm. in diameter, surface rugose to cerebriform, minutely areolate, elevated and coarsely crenulate, subpruinose, between Naples yellow and olive buff, darkening; lower surface smooth, light ochraceous buff, blackening, without rhizinae; upper cortex about 20 μ thick, subfastigiate, decomposed to pseudoparenchymatous but not darkened except occasionally when the outer cell-walls are slightly so, cells 3–4 μ in diameter, loosely arranged, covered by a gelified layer up to 60 μ thick, cracked into areoles of very unequal size; algal layer 40–50 μ thick, 25–60 μ below the upper cortex, cells up to 9 μ in diameter, protococcoid, more or less grouped in small colonies; medulla commonly 140–175 μ thick but expanding to 400 μ, of hyphae 2–4 μ in diameter, branched and anastomosed, vertical and branched above the algal layer, irregularly interwoven in the central portion, fibrous and dense for 30–40 μ next the lower cortex which is 30–40 μ thick, dense, pseudoparenchymatous, mostly very dark, sometimes without color.

Apothecia very young, black, sessile to somewhat immersed; cortex 35 μ, fastigiate, inner portion similar to that of the thallus, hyphae ending in thick-walled black cells about 15 μ thick which extend over the disc at this stage; parathecium thin, hyaline, of slender, densely woven hyphae; hypothecium about 60 μ thick, very deeply staining; thecium about 60 μ tall; paraphyses slender, about 1 μ in diameter; young asci clavate with a gelified sheath, filled with deeply staining protoplasm.

Spermogonia flask-shaped when young, becoming flattened and irregular with a small ostiole; wall carbonaceous, black, of small-celled pseudoparenchyma; spermatiophores flexuous,

slender, closely septate; spermatia bacilliform, straight, short. The old spermogonia are frequently invaded by hyphae of *Hormiscium*.

On quartzite and granite, leuco-sodaclase granodiorite, porphyritic diabase, and crypto-crystalline pink granite.

King Edward VII Land: Rockefeller Mts., Mt. Helen Washington, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff HW-10, HW-11, HW-12a, HW-13.*

Marie Byrd Land: Edsel Ford Range, Skua Gull Peak, *P. Siple & S. Corey 72W-15*, type; Mt. Grace McKinley, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff McK-6, McK-8.*

Umbilicaria **pateriformis** Dodge & Baker, sp. nov.

Pl. 44, figs. 105–106.

Type: Marie Byrd Land, Edsel Ford Range, Skua Gull Mt., *P. Siple & S. Corey 72W-13.*

Thallus monophyllus, ad 1 cm. diametro, laevis, minute areolatus, marginibus laevibus aut sublaceratis, fragilibus, olivaceo-alutaceus, nigricans, subtus niger, laevis, sine rhizinis; cortex superior circa 20 μ crassitudine, cellulis 4–5 μ, isodiametricis, strato ad 20 μ crassitudine gelifacto diffracto tectus; stratum gonidiale 15–25 μ crassitudine, 20–40 μ sub cortice superiori, cellulis ad 9 μ diametro, protococcoideis; medulla 90–125 μ crassitudine, hyphis tenuibus circa 0.75 μ diametro, ramosis anastomosantibusque, super algas verticaliter, sub algis irregulariter contextis et ad corticem inferiorem periclinaliter dispositis; cortex inferior circa 20 μ crassitudine, cellulis 4–7 μ diametro, isodiametricis, pachydermaticis, nigris. Sterilis.

Thallus monophyllous, up to 1 cm. in diameter, surface smooth, minutely areolate, margin smooth, occasionally somewhat lacerate, rather fragile, between chamois and deep olive buff, blackening, below smooth, black, without rhizinae; upper cortex about 20 μ thick, pseudoparenchymatous to fastigiate, cells 4–5 μ in diameter, covered with a broken gelified layer up to 20 μ thick; algal layer 15–25 μ thick, 20–40 μ below the upper cortex, cells up to 9 μ in diameter, protococcoid; medulla 90–125 μ, of slender hyphae about 0.75 μ in diameter, branched and anastomosed, regular and vertical above the algal layer, irregularly woven below and becoming periclinal next the lower cortex which is about 20 μ thick, cells 4–7 μ, isodiametric, thick-walled, dark, much denser than the upper cortex. Apothecia not seen.

We have hesitated to describe this as a distinct species, since

it is sterile and small. It may be only a juvenile stage of *U. cerebriformis*, yet many small thalli of the latter show the beginning of the wrinkling and folding of the upper surface before they have reached the diameter of this. Microscopically they are somewhat similar. Some of the material cited from King Edward VII Land is lighter and some darker than the type.

On granite and fine-grained dike.

KING EDWARD VII LAND: Rockefeller Mts., Mt. Helen Washington, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff HW-13.*

MARIE BYRD LAND: Edsel Ford Range, Skua Gull Peak, *P. Siple & S. Corey 72W-13*, type.

UMBILICARIA **cristata** Dodge & Baker, sp. nov.

Pl. 45, figs. 122–126.

Type: King Edward VII Land, Rockefeller Mts., Mt. Helen Washington, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff HW-1a.*

Thallus monophyllus, 2–3 cm. diametro, laevis aut centro verrucosus rugosusque, marginibus sublaceratis, rhizinosis, fragilis siccatus, cinereo-pruinosus, centro minute rimuloso-areolato, subtus fuscus marginibus dilutioribus; rhizinae cylindricae, ramosae, apicibus ramisque cinereis; cortex 5–10 μ crassitudine, pseudoparenchymaticus, cellulis 3–5 μ diametro, exteris obscuris, strato 3–6 μ crassitudine cellularum emortuarum tectus; algae ad 10 μ diametro, protococcoideae, sub cortice superiore sparsae; medulla 140–150 μ crassitudine, hyphis 2–3 μ diametro, ramosis anastomosantibusque, insuper reticulatim, subtus periclinaliter dispositis; cortex inferior 30–40 μ crassitudine, pseudoparenchymaticus, cellulis exteris obscuris; rhizinae hyphis periclinalibus cum cortice pseudoparenchymatico; stipes irregularis, 1.5–2.5 mm. diametro, cavitate centrali 1 mm. diametro; cortex obscurus, medulla hyalina, cellulis compactis verticalibus, sine algis.

Thallus monophyllous, 2–3 cm. in diameter, surface smooth or verrucose and rugose near the center, margin somewhat lacerate with dense tufts of rhizinae, very brittle when dry, ashy pruinose, minutely rimulose-areolate, especially toward the center, below fuscous, margins lighter with occasional cylindrical branched rhizinae, tips and branches ashy; upper cortex 5–10 μ thick, of loose pseudoparenchyma, the cells 3–5 μ in diameter, outer ones dark, the whole covered by an irregular layer of dead cells 3–6 μ thick; algae up to 10 μ in diameter, protococcoid, scattered near the cortex; medulla 140–150 μ thick, of branched and anastomosing hyphae 2–3 μ in diameter, loosely

reticulate above, more or less periclinal near the lower cortex which is 30–40 μ thick, dark on the outside, hyaline within, pseudoparenchymatous; rhizinae dark with a pseudoparenchymatous cortex continuous with that of the thallus and with periclinal hyphae within; stipe very irregular in cross-section, 1.5–2.5 mm. in diameter with a central opening 1 mm. in diameter; cortex dark, medulla hyaline, of compact vertical cells. In longitudinal section the compact basal portion pseudoparenchymatous, the fibrous vertical tissue 14–20 μ thick, the cells 1–3 μ in diameter, and a dark cortex on the outside with no cortex on the inside. Sterile.

On coarse-grained granite.

KING EDWARD VII LAND: Rockefeller Mts., Mt. Helen Washington, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff HW-1a*, type.

UMBILICARIA **spongiosa** Dodge & Baker, sp. nov.

Pl. 45, figs. 111–121.

Type: Marie Byrd Land, Edsel Ford Range, Lichen Peak, *P. Siple & S. Corey 73-9.*

Thallus monophyllus, ad 15 cm. diametro, fragilis, profunde reticulatimque rugosus, centro verrucosus ad margines laevior impressusque, marginibus laevibus, crispatis, non laceratis, coriaceus, obscure brunneus vel ravus, pruinosus, centro subareolato, subtus sepiaceus, laevis, dense rhizinosus; rhizinae sepiaceae ad thallum, dilutiores ad apices, subramosae, cylindricae, non in trabeculis anastomosantes; cortex superior 20–25 μ crassitudine, cellulis pachydermaticis, 2–3 μ diametro, pseudoparenchymaticus, strato 2–4 μ crassitudine cellularum emortuarum tectus; stratum gonidiale ad 75 μ crassitudine, cellulis protococcoideis, ad 12 μ diametro; medulla 250–400 μ crassitudine, hyphis 2.5–3 μ diametro, irregulariter dispositis; cortex inferior 10–20 μ crassitudine, cellulis exteris pachydermaticis, obscuris, isodiametricis; rhizinae hyphis ramosis, tenuibus, raro anastomosantibus, cortice pseudoparenchymatico, circa 10 μ crassitudine tectae; stipes 1.5–2 mm., cavitatibus centralibus aut lateralibus, cortex fuscus irregularis, pseudoparenchymaticus; medulla hyphis densissimis contexta, sine algis.
Spermogonia 400 μ altitudine, 325 μ diametro ad basim, ad ostiolam tenuescens, ostiola circa 150 μ diametro; murus cellulis obscuris compactis, 5–7 μ diametro; spermatiophorae ramosae, 1 μ diametro, apicibus attenuatis; spermatia 1 × 0.5 μ, recta.

Thallus monophyllous, up to 15 cm. in diameter (greatly broken in transit, fragments 5–6 cm.), surface deeply reticulate-rugose and verrucose in center, smoother and only impressed at margin which is smooth, not torn, and very much crisped, leathery when dry, mummy brown to light buff, prui-

nose, very slightly areolate in center, otherwise not cracked, below sepia, smooth, very densely rhizinose; rhizinae sepia next the thallus, becoming pale pinkish buff toward the tips, sparingly branched, cylindric, not anastomosing into trabeculae; upper cortex 20–25 μ thick, surface very uneven, cells thick-walled, 2–3 μ in diameter, isodiametric, not darkened, the whole covered by a layer of dead cells 2–4 μ thick or lacking entirely; algal layer up to 75 μ thick, cells up to 12 μ in diameter, protococcoid; medulla 250–400 μ thick, of hyphae 2.5–3 μ in diameter, irregularly arranged, often somewhat periclinal next the lower cortex which is 10–20 μ thick, the outer cells isodiametric, thick-walled, dark; rhizinae of slender branched, rarely anastomosed hyphae, covered with a pseudoparenchymatous cortex about 10 μ thick; stipe central, 1.5–2 mm. in diameter, in section irregular in outline with small openings either central or lateral, of compact hyphal tissue covered both externally and internally by a dark irregular pseudoparenchymatous cortex, without algae.

Spermogonia 400 μ tall, 325 μ in diameter at the base, tapering to a narrower neck, about 150 μ in diameter; the wall of compact dark cells 5–7 μ in diameter; spermatiophores branched, about 1 μ in diameter, tapering at the ends; spermatia 1 × 0.5 μ, straight.

On sericite-orthoclase schist or on sandy loam.

MARIE BYRD LAND: Edsel Ford Range, Lichen Peak, *P. Siple & S. Corey 73–9*, type; Skua Gull Peak, *P. Siple & S. Corey 72W-1, 72W-15.*

LECANORACEAE

Thallus crustose, uniform or with effigurate margins, rarely dwarf-fruticose, branched, attached to the substrate by the hyphae of the prothallus or of the medulla, without rhizinae, heteromerous except in *Harpidium*; ecorticate or corticate; with *Protococcus*. Apothecia immersed in the thallus or sessile, round; amphithecium well developed; parathecium poorly developed or lacking; hypothecium hyaline, usually with algae below; paraphyses unbranched and free or branched and intricate; asci 8–32-spored; spores hyaline, rarely brownish, uni-

cellular, 2 or more celled or muriform and many-celled, thin-walled.

KEY TO ANTARCTIC GENERA

Spores unicellular; paraphyses unbranched and free.
  Thallus gray or white .... *Lecanora*
    Thallus not effigurate; no parathecium.
      Apothecia immersed, concave .... *Aspicilia*
      Apothecia sessile .... *Eulecanora*
    Thallus effigurate; parathecium often highly developed but algal layer under the hypothecium.
      Cephalodia absent.
        Apothecia sessile; alpine, Arctic and Antarctic .... *Squamaria*
        Apothecia immersed; Kerguelen Island .... *Urceolina*
      Cephalodia present.
        Apothecia sessile; Arctic, alpine .... *Placopsis*
        Apothecia immersed, disc concave .... *Aspiciliopsis*
    Thallus dwarf-fruticulose; California .... *Cladodium*
  Thallus bright yellow .... *Candelariella*
Spores uniseptate (rarely pluriseptate); paraphyses unbranched and free.
    Thallus gray or brown .... *Lecania*
      Thallus crustose .... *Eulecania*
      Thallus squamulose .... *Solenospora*
      Thallus fruticulose .... *Thamnolecania*
    Thallus bright yellow .... *Candelariella*

LECANORA

Lecanora Acharius, Lichenogr. Univ. 77. 1810.

The type species is not designated.

Thallus crustose, uniform or effigurate or squamose and small-foliose, seldom dwarf-fruticose, attached to the substrate by the hyphae of the hypothallus or of the medulla, without rhizinae, heteromerous; ecorticate or corticate; algae *Protococcus*. Apothecia immersed or sessile, circular; amphithecium well developed; parathecium usually absent or poorly developed, rarely well developed; paraphyses unbranched, free; hypothecium hyaline or colored; asci normally 8-spored, rarely 16–32-spored; ascospores hyaline, ellipsoidal, elongate to spherical, rarely kidney-shaped, thin-walled without a sheath. Spermatia bacilliform, cylindric or filiform, straight or curved.

The characters of the sections which are often recognized as genera are given above in the Key to the Genera.

KEY TO ANTARCTIC SPECIES OF OCHROLECHIA AND LECANORA

Spores large, often less than 8 per ascus; paraphyses conspicuously and intricately branched, forming an epithecium 40 μ or more thick.....*Ochrolechia*
 Spores 44–76 × 30–40 μ; asci 256 × 70 μ, 4-spored..............*O. Deceptionis*
 Spores 22–40 × 18–26 μ; asci 180 × 50 μ, 6-8-spored................*O. frigida*
Spores much smaller, 8 per ascus; paraphyses simple or sparingly branched near the tip, forming a much thinner epithecium.................*Lecanora*
 Thallus effigurate to squamulose..................................SQUAMARIA
  Apothecia adnate; thallus white-virescent..................*L. Babingtonii*
  Apothecial stalk highly developed, often appearing subpodetiiform.
   Apothecial margin yellowish ashy, crenulate, lobed, gemmiferous; thallus yellowish ashy..............................*L. Daltoniana*
   Apothecial margin ochraceous buff to light ochraceous buff, crenulate, not lobed, smooth; thallus light ochraceous buff...........*L. exsulans*
   Apothecial margin deep olive buff, smooth; thallus smoke gray to drab ....*L. Siplei*
 Thallus crustose...EULECANORA
  Thallus microphylline with ascending narrow laciniae.
   Laciniae 1–1.5 mm. long, black variegated, cortex 20 μ, fastigiate; apothecia 0.3–0.8 mm. in diameter..................*L. leucomelaena*
   Laciniae 6–7 mm. long, white straw color, cortex 30–60 μ, decomposed; apothecia 1–5 mm. in diameter.....................*L. Charcotiana*
 Thallus uniform, granulose, verrucose, or areolate.
  Spores 12–22 × 7–12 μ.
   Thallus white to greenish ashy; apothecia 1–2 mm...........*L. subfusca*
   Thallus rufescent; apothecia 0.75 mm., subimmersed; paraphyses corymbose-branched.................................*L. alutacea*
  Spores usually less than 15 × 8 μ.
   Thallus yellowish to greenish citrine.
    Thallus sorediose.................................*L. orostheoides*
    Thallus not sorediose.
     Epithecium dark.
      Thecium 60 μ; spores 10–15 × 5–5.5 μ................*L. humillima*
      Thecium 80–90 μ; spores 7–11 × 5–7 μ................*L. Gainiana*
     Epithecium pale.
      Thallus 2.5 mm. thick, rimose-rugose; thecium 120–140 μ...... ....*L. miranda*
      Thallus thinner.
       Apothecia 0.5–1.0 mm.; thallus inconspicuous......*L. Mons-Nivis*
       Apothecia larger.
        Apothecia substipitate......................*L. aspidophora*
         Thallus reduced; disc black, KOH green.........v. *aterrima*
         Thallus granulose, verrucose, warts 1–3 mm., KOH yellow; disc reddish-flesh color, KOH–, apothecial stipe 1.5–3 mm.................................v. *errabunda*
         Thallus verrucose, warts 2–4(–6) mm., KOH–; disc pale straw, KOH–, apothecial stipe 1–1.5 mm........v. *typica*

Apothecia sessile .... *L. polytropa*
Spores 12–13 × 6–8 μ; apothecia pale .... v. *leptacinoides*
Spores 10–13 × 4–5 μ.
Apothecia pale, thalline warts and areoles small, usually dispersed .... v. *illusoria*
Apothecia often blackened, areoles and warts usually contiguous .... v. *intricata*
Thallus white.
Hypothecium and paraphyses violet purple .... *L. atra* v. *vulgaris*
Hypothecium and paraphyses hyaline or nearly so.
Thallus thin, tartareous to obsolete .... *L. expectans*
Thallus smooth, areolate; disc fuscous black.
Apothecia 0.4–0.8 mm. .... *L. tephroeceta*
Apothecia 1–3 mm. .... *L. dancoensis*
Apothecia simple .... f. *normalis*
Apothecia proliferous .... f. *prolifera*
Thallus granulose to verrucose.
Apothecia 0.5–1.0 mm., margin white, lobulate .... *L. margaritae*
Apothecia 1–2 mm., margin fuscous .... *L. epibryon*
Thallus gray.
Apothecia 0.5 mm.; thalline warts 2–3(–5) mm. .... *L. poliophaeoides*
Apothecia 1–1.2 mm.; thallus powdery, granular.
Spores 10–12 × 4–5 μ, margin white; thallus very inconspicuous, saxicolous .... *L. lavae*
Spores 8.5–12.5 × 5–6 μ, margin gray; thallus granular, rugose, muscicolous .... *L. griseomarginata*
Thallus lilac to lilac fuscous, ecorticate.
Apothecia 1.2 mm.; spores 8–10 × 4–6 μ .... *L. lilacina*
Apothecia 0.65 mm.; spores 11.5–13 × 4.5–5.5 μ .... *L. lilacinofusca*
Thallus olive buff or brownish, corticate.
Apothecia usually over 1 mm.; spores 10–16 × 4–6 μ .... *L. badia*
Apothecia under 0.8 mm.
Spores 9–11 × 4–4.5 μ; medulla 50–60 μ .... *L. carbonacea*
Spores 13–15 × 4–6.5 μ; medulla 300 μ.
Apothecia 0.4 mm.; asci 46–48 × 12.5–14 μ; young spores appendiculate .... *L. fuscobrunnea*
Apothecia 0.75 mm.; asci 58–61 × 14–15 μ, young spores not appendiculate .... *L. subolivacea*

LECANORA **exsulans** (Th. Fries) Dodge & Baker, n. comb.

Lecanora chrysoleuca (Smith) Acharius var. *melanophthalma* (Ram.) Th. Fries, f. *exsulans* Th. Fries, Nyt Mag. Naturvidensk. **40**: 208. 1902.

Lecanora rubina (Vill.) Ach. var. *melanophthalma* (Ram.) Zahlbr. f. *exsulans* (Th. Fries) Zahlbr., Cat. Lich. Univ. **5**: 660. 1928.

Type: S. Victoria Land, Geikie Land [71° 40′ S., 170° E.], 100 m., *C. E. Borchgrevink* (in Upsala and Oslo).

Thallus in pulvinate tufts up to 2.2 cm. in diameter and 5–6 mm. high, rather fragile, deeply scrobiculate, thick, margin crenulate in young specimens, soon concealed by the apothecia which are sessile at first, becoming stalked, light ochraceous buff to ochraceous buff (dry).

Apothecia up to 4 mm. in diameter, disc light ochraceous buff at first, becoming dusky green, slightly pruinose, margin remaining concave, thin and smooth at first, becoming thicker and crenate, exciple smooth at first, becoming rugose-sulcate.

Growing over *Sarconeurum glaciale.*

SOUTH VICTORIA LAND: Geikie Land, 71° 40′ S. 170° E., 100 m., *C. E. Borchgrevink;* Newnes Land, 20 m., *C. E. Borchgrevink.*

LECANORA **Siplei** Dodge & Baker, sp. nov.

Pl. 47, figs. 146–151; pl. 63, figs. 413, 415.

Type: Marie Byrd Land, Edsel Ford Range, Skua Gull Peak, *P. Siple & S. Corey 72W-13.*

Thallus funiculatus aut in areolis ad 0.9 mm. diametro, coriaceus, aut sub apotheciis inconspicuus, griseo-fumatus vel ravus, fuscus madefactus, ad 650 μ crassitudine; cortex superior ad 40 μ crassitudine, fastigiatus, hyphis 1–2 μ diametro, pachydermaticis, strato gelifacto circa 4 μ crassitudine tectus; stratum gonidiale ad 100 μ crassitudine, protococcoideum, cellulis ad 10 μ diametro, raro in coloniis per totum thallum sparsis; medulla 300–500 μ crassitudine, hyphis 2–3 μ diametro, irregulariter reticulatimque implexis, densioribus circum algas; cortex inferior superiori similis cum cellulis isodiametricis obscuris exteris sparsis.

Apothecia ad 3 mm. diametro, singula aut in catervis ad 3 cm. diametro, plus minusve circularia, juventute marginibus inflexis, dein plana vel etiam repanda, marginibus crenulatis, obscure olivaceo-alutaceis, disco viridi-nigricante; amphithecium 120–150 μ crassitudine, cortex ut in thallo, sed strato gelifacto crassiori ad 50 μ, algae densissime per medullam compactae vel solo sub hypothecio; parathecium deest; hypothecium 8–10 μ crassitudine, hyphis tenuibus dense subpericlinalibus compactum, hyalinum; thecium 30–40 μ altitudine; paraphyses 1–1.5 μ, apicibus 1.5–2.5 μ diametro, gelifactis non obscuris, septati, simplices vel ramosi; epithecium 10–15 μ, hyalinum obscurascensque; asci 33–40 × 10–15 μ, clavati, vaginati; ascosporae octonae, 6.5–8 × 3.5–4.5 μ, late ellipsoideae, raro subreniformes, hyalinae.

Assimilative thallus up to several centimeters in diameter, in rugged strands or areolate, the areolae up to 0.9 mm., leathery, or inconspicuous and limited to the basal regions of the apothecia, hard and leathery when dry, smoke gray to drab,

becoming flexible and fuscous when moist, up to 650 μ thick; upper cortex up to 40 μ thick, fastigiate, marginal hyphae free, subdistant, branched near the surface, 1 μ in diameter, expanding to terminal cells 2 μ in diameter, cell contents much reduced, covered by a gelified layer about 44 μ thick; algal layer up to 100 μ thick, protococcoid, cells up to 10 μ, sometimes scattered throughout the medulla which is 300–500 μ thick, of slender hyphae 2–3 μ in diameter, irregularly interwoven in a close net, denser about the algae; lower cortex similar to the upper with the same darkening near the base, also showing scattered dark pseudoparenchymatous cells on the outside.

Apothecia up to 3 mm. in diameter, single or in clusters as large as 3 cm. in diameter, more or less circular, deeply inrolled when young, opening to flat and even repand at maturity, sage green to deep slate olive or dull greenish black when well developed, light, plane or crenulate, deep olive buff or chamois, disc from sage-green to black; amphithecium 120–150 μ thick, cortex continuous and identical with that of the thallus; algae densely packed throughout the medulla or restricted to a layer beneath the hypothecium, the gelified layer on the outer surface up to 50 μ thick; parathecium not differentiated; hypothecium 8–10 μ thick, hyaline, of closely interwoven hyphae mostly periclinal; thecium 30–40 μ tall; paraphyses 1–1.5 μ, broadening to tips 1.5–2.5 μ, usually not darkened although frequently with enlarged gelified heads, septate, branched or simple; epithecium 10–15 μ, varying from light to dark; asci 33–40 × 10–15 μ, clavate, with a moderately thick gelified sheath, 8-spored; ascospores 6.5–8 × 3.5–4.5 μ, broadly ellipsoidal, rarely somewhat reniform, hyaline.

On soil from dark greenish gray slate and orthoclase-sericite-siderite schist.

MARIE BYRD LAND: Edsel Ford Range, Skua Gull Peak, *P. Siple & S. Corey 72W-4, 72W-13*, type, *72W-14, 72W-15*.

LECANORA **griseomarginata** Dodge & Baker, sp. nov.

Pl. 47, figs. 152–156.

Type: Marie Byrd Land, Edsel Ford Range, Mt. Donald Woodward, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff DW-1*.

Thallus 1–1.5 mm. diametro, crustosus, rugosus, inconspicuus, griseo-albus, mollis gelifactusque madefactus; cortex 20–30 μ crassitudine, cellulis parvis isodiametricis, strato gelifacto tectus; algae protococcoideae, ad 10 μ diametro, sparsae aut in strato 50 μ crassitudine basaliter dispositae; medulla 200–450 μ crassitudine, hyphis tenuibus laxe reticulatimque dispositis; cortex inferior non bene evolutus, cellulis obscurioribus, plus minusve amorphus cum cellulis magnis, liberis, obscuris, isodiametricis.

Apothecia ad 1.2 mm. diametro, irregulariter circularia, marginibus prominentibus, inflexis juventute, expansis repandisve maturitate, nigra, griseo-marginata; amphithecium 80–150 μ crassitudine, cortice ei thalli simili, cum paucis cellulis liberis obscuris isodiametricis; medulla cum eo thalli continua, algis lateraliter abundantibus, paucis sub hypothecio; parathecium 15–20 μ crassitudine, hyalinum; hypothecium centro 70 μ crassitudine, lateraliter ad 10 μ tenuescens, insuper in parathecium expansum; thecium 55–60 μ altitudine; paraphyses 0.5–1 μ, recti, simplices, cellulis apicalibus frequenter obscuris vagina 7 × 10 μ tectis, epithecium 10–12 μ, obscurum; asci 46–54 × 11–18.5 μ, late clavati maturitate; ascosporae octonae, 8.5–12.5 × 5–6 μ, ellipsoideae, hyalinae.

Thallus 1–1.5 mm. in diameter, crustose, rugose but quite inconspicuous, grayish white, mostly limited to the apothecial regions, when moist soft and somewhat gelified; cortex 20–30 μ thick, pseudoparenchymatous, of very small cells, covered by a thin gelified sheath which is often lacking in places and replaced by large dark isodiametric cells, which often penetrate the medulla a long way; algae up to 10 μ in diameter, protococcoid, scattered or in a zone about 50 μ thick in the basal region; medulla 200–450 μ thick, of loosely woven slender hyphae; lower cortex not differentiated beyond the darkening of cells which also become more or less amorphous, and the presence of free, large, dark, isodiametric cells.

Apothecia up to 1.2 mm. in diameter, irregularly circular, margin inrolled when young, expanded to almost repand at maturity, black with a gray margin; amphithecium 80–150 μ thick, cortex continuous with that of the thallus, with a few free dark isodiametric cells; medulla also continuous with that of the thallus, algae abundant laterally but few below the hypothecium; parathecium 15–20 μ, hyaline; hypothecium 70 μ thick in the center, thinning laterally to 10 μ and expanding above into the parathecium; thecium 55–60 μ tall; paraphyses 0.5–1.0 μ in diameter, straight, septate, simple, not expanding above but apical cell covered by a large gelified sheath 7 μ in diameter and 10 μ long, usually darkened, epithecium 10–12 μ,

dark; asci 46–54 × 11–18.5 μ, broadly clavate at maturity, 8-spored; ascospores 8.5–12.5 × 5–6 μ, ellipsoidal, hyaline.

On loose sandy loam, on clumps of mosses and dark greenish gray slate.

Marie Byrd Land: Edsel Ford Range, Mt. Donald Woodward, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff DW-1*, type, *DW-3*; Skua Gull Peak, *P. Siple & S. Corey 72W-2, 72W-3, 72W-9, 72W-14*; Lichen Peak, *P. Siple & S. Corey 73-3, 73-4, 73-7.*

Lecanora **lilacina** Dodge & Baker, sp. nov.

Pl. 47, figs. 157–160.

Type: Marie Byrd Land, Edsel Ford Range, Lichen Peak, *P. Siple & S. Corey 73-7.*

Thallus rarus, inconspicuus, granulosus, dilute lilacinus; ecorticatus; algae ad 12 μ diametro, protococcoideae, per totum thallum sparsae; medulla ad 200 μ crassitudine, hyphis 3–4 μ diametro, laxe implexis; cortex inferior deest.

Apothecia ad 1.2 mm. diametro, irregularia, repanda, marginibus crenulatis, olivaceis, umbrina obscuriorave, juventute lilacina, plana, emarginata; amphithecium 60–75 μ, cortex 30–40 μ, pseudoparenchymaticus, cellulis exteris obscurioribus; parathecium circa 5 μ crassitudine, hyalinum, hyphis periclinalibus; hypothecium centro circa 20 μ, lateraliter tenuescens, hyalinum; thecium 50–80 μ altitudine; paraphyses 1 μ diametro, sub apicibus ramosi, capitibus ad 3 μ diametro, septati, vaginati, gelifacti, epithecium 5–8 μ, hyalinum; asci 38–44 × 11–14 μ, breve clavati, vaginati; ascosporae octonae, 8–10 × 4–6 μ, late ellipsoideae, hyalinae, juventute vaginatae.

Assimilative thallus very scant, inconspicuous, granulose, pale drab gray; ecorticate; algae up to 12 μ in diameter, protococcoid, scattered throughout the thallus; medulla up to 200 μ thick, of rather coarse hyphae 3–4 μ in diameter, loosely woven; lower cortex absent. Myxophyceae, mostly *Stigonema,* cling to the outer surfaces, sometimes in well-defined patches but do not form true cephalodia.

Apothecia up to 1.2 mm. in diameter, irregularly circular, pale drab gray, flat and emarginate when young, becoming convex, Saccardo's umber to chaeṭura black with crenulate margins olive buff and light olive gray; amphithecium 60–75 μ, cortex 30–40 μ thick, pseudoparenchymatous, the outer cells somewhat darkened occasionally with patches of foreign algae; medulla identical and continuous with that of the thallus; parathecium about 5 μ thick, hyaline, of periclinal hyphae;

hypothecium hyaline, about 20 μ thick at the center, thinning rapidly toward the outer edge; thecium 50–80 μ high; paraphyses 1 μ, heads 3 μ expanding abruptly, branched just below the tips, septate with a thick sheath, outer surfaces a little darkened, gelified, epithecium 5–8 μ, hyaline; asci 38–44 × 11–14 μ, short- but slender-clavate with a thick sheath, 8-spored; ascospores 8–10 × 4–6 μ, hyaline, broadly ellipsoidal, with a sheath when young.

On sandy loam, light pink leucogranite, and gray slate.

MARIE BYRD LAND: Edsel Ford Range, Mt. Rea-Cooper, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff R-1*; Lichen Peak, *P. Siple & S. Corey 73-4, 73-7*, type.

LECANORA **lilacinofusca** Dodge & Baker, sp. nov.

Pl. 48, figs. 161–166.

Type: Marie Byrd Land, Edsel Ford Range, Lichen Peak, *P. Siple & S. Corey 73-4.*

Thallus ad 0.95 mm. diametro, inconspicuus, lilacino-fuscus, mollissimus gelifactusque madefactus; ecorticatus; algae ad 15 μ diametro, protococcoideae, coloniis parvis per totum thallum sparsae; medulla ad 500 μ crassitudine, hyphis tenuibus, 1 μ diametro, laxissime implexis, compactioribus ad margines apotheciaque; stratum basale deest.

Apothecia ad 0.65 mm. diametro, irregularia, marginata, concava et alba juventute dein griseo-brunnea, sessilia; amphithecium 50–60 μ crassitudine, cortex circa 10 μ crassitudine, male evolutus, pseudoparenchymaticus, medulla compacta, reticulata, algae sparsae aut in coloniis; parathecium paucis cellulis male evolutum; thecium 50–70 μ altitudine; paraphyses circa 1 μ diametro, capitibus 5 μ diametro, obscure viridibus brunneisve, simplices aut sub apicibus ramosi, septati, vaginati, epithecium viridi-brunneum, 8–10 μ crassitudine; asci 48–55 × 13–16 μ, elongato-clavati, vaginati; ascosporae octonae, 11.5–13 × 4.5–5.5 μ, ellipsoideae, apicibus subacutis obtusisve, hyalinae.

Assimilative portions up to 0.95 mm. in diameter, inconspicuous, brownish-drab, very soft and gelified when moist; cortex absent; algae up to 15 μ in diameter, protococcoid, rare, scattered throughout the thallus in small colonies; medulla up to 500 μ thick, of slender hyphae about 1 μ in diameter, very loosely woven, slightly more compact near the margins and apothecia; basal layer not developed.

Apothecia up to 0.65 mm. in diameter, irregularly circular, concave when young with a slight margin at maturity, white becoming dark gray-brown, sessile, scant; amphithecium 50–

60 μ thick, cortex about 10 μ thick, poorly developed, pseudoparenchymatous, becoming indistinct below at the confluence with the thallus, algae rather abundant, scattered throughout, singly or in groups; parathecium scarcely distinguishable, limited to a few cells at the apothecial margin; hypothecium about 20 μ thick, compact, of slender interwoven hyphae; thecium 50–70 μ tall; paraphyses about 1 μ in diameter expanding to heads about 5 μ in diameter, dark green to brown, septate with a close sheath, epithecium 8–10 μ thick, greenish-brown; asci 48–55 × 13–16 μ, elongate-clavate with a moderate sheath, 8-spored; ascospores 11.5–13 × 4.5–5.5 μ, ellipsoidal, the ends sometimes a little pointed, mostly blunt, hyaline.

Among mosses on loose sandy loam.

MARIE BYRD LAND: Edsel Ford Range, Lichen Peak, *P. Siple & S. Corey 73-4*, type.

LECANORA **carbonacea** Dodge & Baker, sp. nov.

Pl. 46, figs. 142–145.

Type: Marie Byrd Land, Edsel Ford Range, Skua Gull Mt., *P. Siple & S. Corey 72W-6*.

Thallus ad 1 mm. diametro, crustosus, plus minusve continuus, subgranulosus, sparsus, inconspicuus madefactus, alutaceus; cortex 20–30 μ, fastigiatus, reticulatusve aut paucis cum cellulis obscuris isodiametricis; algae protococcoideae, ad 10 μ diametro, sparsae vel in strato 30–60 μ crassitudine sub cortice dispositae; medulla 50–60 μ crassitudine, hyphis laxe reticulatimque dispositis; cortex inferior non bene evolutus, paucis cellulis obscuris isodiametricis sparsis.

Apothecia ad 0.75 mm. diametro, applanata, margine subcrenulata, nigra, carbonacea; amphithecium 50–70 μ crassitudine; cortex bene evolutus, ei thalli similis; parathecium 20–35 μ crassitudine, cellulis fastigiatis, exteris obscuris; hypothecium centro 20–30 μ crassitudine, lateraliter tenuescens ad 10 μ crassitudine, hyalinum; thecium 40–50 μ altitudine; paraphyses 0.75–1.0 μ diametro, septati, non ramosi, capitibus ad 5 μ diametro, obscuris, epithecium 5–12 μ, subvirescens, KOH–; asci 37–43.5 × 12–15 μ, breviter clavati, basi obtusi latique, vaginati; ascosporae octonae, (8–) 9–11 × 4–4.5 μ, ellipsoideae vel subreniformes aut ovoideae, hyalinae.

Thallus up to 1 mm. in diameter, crustose, more or less continuous, somewhat granulose when soaked and loosened from the rock, scattered, inconspicuous, dull tan; cortex 20–30 μ thick, fastigiate, closely interwoven, or sometimes lacking except for a few scattered dark isodiametric cells; algae up to 10 μ in diameter, protococcoid, scattered in the thallus or in a

layer 30–60 μ thick below the cortex; medulla 50–60 μ thick, of loosely reticulate hyphae, occasionally more or less amorphous near the base; lower cortex not differentiated beyond dark isodiametric cells, scattered and not continuous.

Apothecia up to 0.75 mm. in diameter, flattened, more or less circular in outline with a suggestion of a crenulate margin and a faint rim, black, very carbonaceous; amphithecium 50–70 μ thick; cortex well developed, with abundant algae, of the same structure as the thallus; parathecium 20–35 μ thick, of fastigiate cells, the outer ones darkened; hypothecium 20–30 μ thick in the center, thinning laterally to 10 μ or less, then expanding upward into the parathecium, hyaline, similar to the cortex but more compact; thecium 40–50 μ tall; paraphyses 0.75–1.0 μ in diameter, slender, septate, usually unbranched (if so, at a considerable distance from the apex), expanding to large heads 5 μ in diameter, with a thick dark cap, epithecium 5–12 μ thick, dark greenish, KOH–; asci 37–43.5 × 12–15 μ, short-clavate, blunt and rather broad at the base with a moderately prominent sheath, 8-spored; ascospores (8–) 9–11 × 4–4.5 μ, ellipsoidal to slightly reniform or ovoid, hyaline.

On fine-grained dike rock.

MARIE BYRD LAND: Edsel Ford Range, Skua Gull Peak, *P. Siple & S. Corey 72W-6.*

LECANORA **fuscobrunnea** Dodge & Baker, sp. nov.

Pl. 48, figs. 172–175.

Type: South Victoria Land, Queen Maud Mts., Durham Point, northeast portal of Thorne Glacier, *Q. A. Blackburn, R. S. Russell, Jr. & S. D. L. Paine QM-4.*

Thallus ad 0.75 mm. diametro, rarus, granulosus, fusco-brunneus albusve, mollis madefactus; cortex pseudoparenchymaticus stratis singulo aut duobus cellularum, insuper cum strato gelifacto ad 50 μ crassitudine; algae ad 15 μ diametro, protococcoideae, rarae, in parte superiore sparsae; medulla ad 300 μ crassitudine, hyphis tenuibus, 1–3 μ, reticulatim et raro laxe dispositis; cortex inferior superiori similis sine strato gelifacto.

Apothecia ad 0.4 mm. diametro, marginata emarginatave, nigra, carbonacea, sessilia; amphithecium 50–70 μ crassitudine, cortex ei thalli similis; algae abundantes, stratum 50 μ crassitudine sub hypothecio formantes; parathecium non evolutum, paucis cellulis inter amphithecium theciumque exceptis; hypothecium circa 10 μ crassitudine, hyalinum, hyphis compacte reticulatimque dispositis; thecium circa

50–60 μ altitudine; paraphyses 1–1.5 μ, sub apice ramosi, capitibus circa 3.5 μ diametro, septati, epithecium obscurum, 10 μ crassitudine, insuper cum strato gelifacto 5–15 μ, KOH–; asci 46–48 × 12.5–14 μ, obtuse clavati; ascosporae octonae, 13–15 × 4–6 μ, ellipsoideae, appendiculatae juventute, vaginatae, hyalinae.

Assimilative thallus up to 0.75 mm. in diameter, scant, granulose, drab brown to white, soft when moistened; cortex of brown to fuscous pseudoparenchyma in one or two layers of cells, denser near the base with a gelified layer on the outer surfaces up to 50 μ thick; algae up to 15 μ in diameter, protococcoid, scattered, in the upper part of the thallus not numerous; medulla up to 300 μ thick, of slender, closely reticulate hyphae 1–3 μ in diameter, occasionally with quite open meshes; lower cortex identical with the upper without the gelified layer on the surface.

Apothecia up to 0.4 mm. in diameter, irregularly circular, emarginate or with a faint rim, black, carbonaceous, sessile; amphithecium 50–70 μ thick, cortex as in the thallus; algae abundant, especially beneath the hypothecium where they often form a layer 50 μ thick; medulla identical and continuous with that of the thallus; parathecium not differentiated save for a few cells between epithecium and amphithecium; hypothecium about 10 μ thick, hyaline, of closely reticulate hyphae; thecium about 50–60 μ tall; paraphyses 1–1.5 μ in diameter, branched near the tips, septate, expanding to heads about 3.5 μ in diameter, slightly darkened on the outside, epithecium dark, about 10 μ thick with a gelified layer 5–15 μ thick, not changing color with KOH; asci 46–48 × 12.5–14 μ, bluntly clavate, 8-spored; ascospores 13–15 × 4–6 μ, ellipsoidal, hyaline, with a thin sheath, when young with appendages at the lower ends which later break off.

On granitic sandy loam.

SOUTH VICTORIA LAND: Queen Maud Mts., Durham Point, northeast portal of Thorne Glacier, *Q. A. Blackburn, R. S. Russell Jr. & S. D. L. Paine QM-4.*

LECANORA **subolivacea** Dodge & Baker, sp. nov.

Pl. 48, figs. 167–171.

Type: Marie Byrd Land, Edsel Ford Range, Mt. Rea-Cooper, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff R-7.*

Thallus ad 0.65 mm. diametro, rarus, subolivaceus, pulvinatus, irregulariter circularis, sparsus aut gregarius, mollis madefactus; cortex ad 30 μ crassitudine, fastigiatus aut ad apothecium pseudoparenchymaticus, cellulis ad 3 μ diametro; algae ad 10 μ diametro, protococcoideae, rarae, coloniis parvis sparsis; medulla ad 300 μ crassitudine, hyphis tenuibus, circa 2 μ diametro, insuper compactis, centro laxissime implexis, basaliter subpericlinalibus; cortex inferior deest.

Apothecia ad 0.75 mm. diametro, pulvinata, emarginata, olivacea nigrave, non nitida, sparsa, singula; amphithecium 80–90 μ crassitudine, cortex 10–30 μ, pseudoparenchymaticus, algae abundantes; parathecium 10–20 μ crassitudine, male evolutum; hypothecium 10–20 μ, hyalinum, non tenuescens; thecium 70–80 μ altitudine; paraphyses 1–1.5 μ diametro, septati, gelifacti, capitibus 3 μ, simplices aut sub capitibus ramosi; epithecium 5–10 μ, obscurum, gelifactum, KOH addito virescens; asci 58–61 × 14–15 μ, tenuiter clavati; ascosporae octonae, 14–15 × 5–6.5 μ, ellipsoideae vel subovoideae, hyalinae.

Assimilative thallus up to 0.65 mm. in diameter, scant, pale olive buff to olive buff, limited to separate pulvinate areolae, irregularly circular, later almost entirely covered by apothecia, scattered or closely clustered, soft when moist; cortex up to 30 μ thick, fastigiate in places, usually pseudoparenchymatous near the apothecium, the cells about 3 μ in diameter; algae up to 10 μ in diameter, protococcoid, rare, in small colonies scattered throughout the thallus; medulla about 300 μ thick, of slender hyphae about 2 μ in diameter, closely reticulate above, very loose in the center and in more or less periclinal strands below; lower cortex not differentiated.

Apothecia up to 0.75 mm. in diameter, pulvinate, without a prominent margin, olive buff to citrine drab or black, not shining, scattered and usually single; amphithecium 80–90 μ thick, cortex 10–30 μ, pseudoparenchymatous, algae abundant throughout; medulla identical and continuous with that of the thallus; parathecium 10–20 μ thick, scarcely distinguished except the few outer cells whose exposed surfaces are darkened as those of the epithecium; hypothecium hyaline, 10–20 μ thick, fibrous, not tapering; thecium 70–80 μ tall; paraphyses 1–1.5 μ, conspicuously septate, expanding to heads up to 3 μ, gelified but not darkened, simple or branched near the tips; epithecium 5–10 μ thick, dark, gelified, turning green with KOH; asci 58–61 × 14–15 μ long, slender-clavate, more broadly so at maturity, 8-spored; ascospores 14–15 × 5–6.5 μ, ellipsoidal to slightly ovoid, hyaline.

On coarse-grained granite.

MARIE BYRD LAND: Edsel Ford Range, Mt. Rea-Cooper, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff R-7.*

CANDELARIELLA

CANDELARIELLA Müll. Arg., Bull. Herb. Boiss. **2**: app. 1: 11. 1894.

The type species is *Candelariella vitellina* (Ach.) Müll. Arg.

Thallus crustose, uniform, horny, verrucose or effigurate (sect. *Caloplacopsis),* bright yellow, not colored red by KOH, attached to the substrate by hyphae of the prothallus or of the medulla, without rhizinae, heteromerous; with *Protococcus.* Apothecia sessile, circular, yellow, not colored red by KOH, lecanorine; hypothecium hyaline with algae below; paraphyses unbranched, non-septate or septate near the tip; asci 8- to many-spored; ascospores hyaline, elongate to ellipsoidal, 1–2-celled with thin septum and walls. Spermogonia very small, punctiform, yellow, spermatiophores scantily septate, forked or branched, short-celled; spermatia short, straight.

No previous reports from Antarctica.

Candelariella chrysea Dodge & Baker, sp. nov.

Pl. 49, figs. 181–191.

Type: Marie Byrd Land, Edsel Ford Range, Chester Mts., *P. Siple & S. Corey 97A-1.*

Thallus conspicuus, pars non-assimilans 250 μ crassitudine, funiculis nigris sub parte assimilativa, cortex 10–30 μ, pseudoparenchymaticus; medulla 150–200 μ crassitudine, cellulis hyalinis; stratum basale ad 50 μ crassitudine, cellulis pachydermaticis brunneis; pars assimilans ad 500 μ crassitudine, cadmii flava, KOH addito immutata, verrucosa; cortex 20–50 μ crassitudine, pseudoparenchymaticus, paucis cellulis fastigiatis exteris, raro cum strato cellularum emortuarum tectus; algae per totam areolam sparsae, cellulis 3–3.5 μ diametro, protococcoideis; medulla circa 350 μ crassitudine, cellulis regularibus compactisque; stratum basale ad 25 μ crassitudine, cortici simile; isidia plus minusve spherica, 100 μ diametro, cortex ad 10 μ crassitudine, pseudoparenchymaticus, algae abundantes, medulla hyphis laxe reticulatimque implexis.

Apothecia 0.5–2 mm. diametro, irregularia vel circularia, marginibus subcrenulatis, non inflexis, sparsa vel gregaria, sessilia in areolis assimilantibus, ochraceo-aurantia; parathecium ad 75 μ crassitudine, ex hypothecio oriens, cellulis tenuibus insuper ramosis, corticem efficiens; hypothecium circa 50–60 μ crassitudine, cellulis isodiametricis verticaliter dispositis, in medullam mergens, hyalinum; thecium ad 175 μ altitudine; paraphyses 1 μ, apicibus 1.5–2.5 μ diametro, clavatis,

ramosi vel non ramosi, evaginati, septati; asci 57–84 × 17–25 μ, polyspori, late clavati, vaginati; ascosporae 10–15 × 4.5–7 μ, ellipsoideae vel subreniformes, raro guttulatae, hyalinae, unicellulares.

Thallus conspicuous over areas of several centimeters, occasionally on rocks but usually with mosses and amongst gravel and soil; non-assimilative portion up to 250 μ thick, macroscopically of blackened strands below the assimilative portions; upper cortex from 10 to 30 μ thick, of regular isodiametric cells with only moderately thickened walls; medulla 150–200 μ thick, of hyaline cells with progressively thinner walls from the cortex to the center; basal cortex up to 50 μ thick, very well developed, of thick-walled cells in a compact layer, brown; assimilative portion up to 500 μ thick, verrucose, cadmium yellow, no color change with KOH; cortex 20–50 μ thick, of regular pseudoparenchyma with a few dark fastigiate cells scattered on the outer surface, occasionally a layer of dead cortical cells outside the fastigiate cells; algae protococcoid, scattered throughout the areole, cells 3–3.5 μ in diameter; medulla about 350 μ thick, of regular and compact cells; basal layer up to 25 μ, not morphologically differentiated from the cortex; isidia more or less spherical, about 100 μ in diameter with a pseudoparenchymatous cortex up to 10 μ thick, internally of loose reticulate hyphae and abundant algae.

Apothecia 0.5–2 mm. in diameter, irregular to circular with the margin slightly crenulate, not inrolled, scattered or in groups, sessile on the assimilative areolae, ochraceous orange; parathecium up to 75 μ thick, spreading from the hypothecium, of slender cells branching at the surface to form the cortex; hypothecium 50–60 μ thick, of cells closely arranged in a palisade, disappearing basally as it merges with the cells of the compact medullar tissue, hyaline; thecium up to 175 μ tall; paraphyses 1 μ in diameter expanding to slightly enlarged apices about 1.5–2.5 μ, clavate, branched or unbranched, without a sheath, septate; asci 57–84 × 17–25 μ, polysporous, broadly clavate with a well-developed gelified sheath; ascospores 10–15 × 4.5–7 μ, ellipsoidal to somewhat reniform, occasionally with faint oil droplets, hyaline.

The exposed surfaces of the assimilative, non-assimilative

and apothecial parts are frequently blackened by the abundance of a dematiaceous hyphomycete. The parasitic cells vary in size (see pl. 49, figs. 181, 182), sometimes surrounding completely a few algae in a more or less spherical mass (see pl. 49, fig. 183a) which possibly function as soredia.

On sandy loam and coarse-grained gray granodiorite.

MARIE BYRD LAND: Edsel Ford Range, Chester Mts., *P. Siple & S. Corey 97A-1*, type, *97A-2*; Lichen Peak, *P. Siple & S. Corey 73-3*.

CANDELARIELLA **albovirens** Dodge & Baker, sp. nov.

Pl. 48, figs. 176–178; pl. 49, figs. 179–180b.

Type: Marie Byrd Land, Edsel Ford Range, Mt. Corey, *P. Siple & S. Corey 112E-2*.

Thallus non assimilans funiculis radiantibus 1–2 mm. longitudine, nigris; areae assimilantes ad 2 mm. diametro, crustosae vel areolatae, arachnoideae, albae, flavovirentes; cortex ad 25 μ crassitudine, non continuus, cellulis fastigiatis confertis, exteris obscuris; stratum gonidiale 20–30 μ crassitudine, cellulis ad 8 μ diametro, raro sparsis; medulla 300–450 μ crassitudine, hyphis circa 3 μ diametro, ramosis, laxe reticulatimque dispositis; cortex inferior non evolutus, paucis cellulis isodiametricis obscuris sparsis.

Apothecia ad 1.5 mm. diametro, concava vel plana maturitate, cylindrica basi attenuata, subsessilia vel sessilia, flava viridiave maturitate, gregaria vel singula; amphithecium 150–180 μ crassitudine, cortex ad 30 μ crassitudine, fastigiatus, continuus cum eo thalli; algae sparsae, abundantes; parathecium non evolutum; hypothecium 40–50 μ crassitudine, hyphis periclinalibus, verticaliter in centro dispositis, densum, hyalinum; thecium 40–60 μ altitudine; paraphyses 1–2 μ diametro, apicibus 3 μ, obscuris, non ramosi, recti, raro e cellulis penultimis ultimisve ramosi, septati, leptodermatici, guttulati, KOH addito subvirescentes; epithecium circa 5 μ crassitudine, tenue, hyalinum; asci 30–35 × 9.5–13 μ, breviter clavati; ascosporae octonae, 7–11 × 3–4 μ, ellipsoideae vel reniformes, hyalinae.

Non-assimilative portions of the thallus represented by black rhizoidal strands radiating for 1–2 mm. from the assimilative and apothecial regions; assimilative parts up to 2 mm., limited almost entirely to the basal portions of apothecia, scant, crustose, areolate to arachnoid, white to yellowish green; cortex up to 25 μ, not continuous over the whole surface, of fastigiate closely packed cells, the outer ones sometimes darkened with occasional scattered patches of dark isodiametric cells; algal layer 20–30 μ thick, protococcoid, cells up to 8 μ in diameter, parallel to the apothecium, rarely scattered in the thallus; medulla 300–450 μ thick, of loosely woven branched

hyphae 3 μ in diameter; lower cortex not developed, covered basally by a few dark isodiametric scattered cells.

Apothecia up to 1.5 mm. in diameter, more or less circular, concave to plane at maturity, cylindrical with attenuated bases, subsessile to sessile, white when young, yellow to green at maturity, gregarious or single; amphithecium 150–180 μ thick, cortex up to 30 μ thick, fastigiate, continuous with that of the thallus, medulla continuous with the thalline medulla, algae scattered, abundant; parathecium not differentiated; hypothecium 40–50 μ thick, of hyphae periclinal toward the sides of the apothecium, but erect and vertical toward the center, dense, hyaline; thecium 40–60 μ tall; paraphyses 1–2 μ in diameter, expanding above, the apical cells up to 3 μ in diameter, darkened on the outer layers, occasionally with a dark encrusting mass adhering to them, mostly simple, straight, septate, sometimes branching from the ultimate or penultimate cells, thin-walled, with conspicuous oil droplets, slightly green with KOH, epithecium about 5 μ, hyaline; asci 30–35 × 9.5–13 μ, short-clavate, 8-spored; ascospores 7–11 × 3–4 μ, slender, ellipsoidal to reniform, hyaline.

On coarse-grained granite and highly weathered coarse-grained leucogranite, quartzite, dark greenish gray slate, and sericite-orthoclase schist.

MARIE BYRD LAND: Edsel Ford Range, Mt. Corey, *P. Siple & S. Corey 112E-2*, type; Chester Mts., *P. Siple & S. Corey 97A-3;* Lichen Peak, *P. Siple & S. Corey 73-1, 73-10;* Skua Gull Peak, *P. Siple & S. Corey 72W-7.*

KING EDWARD VII LAND: Rockefeller Mts., Mt. Helen Washington, *P. Siple & S. Corey HW-11, HW-13.*

LECANIA

LECANIA Massalongo, Alcun. Gen. Lich. 12. 1855.

The type species is *Lecania fuscella* Mass.

Thallus crustose, uniform, effigurate, squamose or dwarf-fruticose, attached to the substrate by the hyphae of the prothallus or of the medulla, without rhizinae, heteromerous; ecorticate or corticate; algae *Protococcus;* medulla loosely woven, of thin-walled hyphae. Apothecia sessile, round, lecanorine; parathecium lacking, incompletely or well developed; hypothecium hyaline with algae below; paraphyses un-

branched; asci normally 8, exceptionally 16–32-spored; ascospores hyaline, elongate to ellipsoid, straight or curved, 2- or more celled, thin-walled with cylindric cells.

The genus is usually divided into three sections (for characters see key to family, p. 568). *Thamnolecania* and *Eulecania* seem to be confined to the Antarctic Archipelago, although *Catillaria inconspicua* from Marie Byrd Land may belong in *Eulecania* as algae are found below the hypothecium but only at the margins.

KEY TO ANTARCTIC SPECIES

Thallus crustose, uniform, white or grayish .... EULECANIA
  Hypothallus white .... *L. Racovitzae*
  Hypothallus black .... *Catillaria inconspicua* (p. 548)
Thallus fruticulose, ascospores 4-celled .... THAMNOLECANIA
  Ascospores 13–24 × 3–4.5 μ; thallus 6–13 mm. high .... *L. Brialmonti*
  Ascospores 10–14 × 4.5–5 μ; thallus 3–5 mm. high .... *L. Gerlachei*
  Ascospores 11–15 × 4 μ; thallus 10–12 mm. high, yellowish fuscescent....
  .... *L. cariosa*

PARMELIACEAE

Thallus foliose, resupinate to erect and almost fruticose, often attached to the substrate by rhizinae, dorsiventral; usually corticate on both surfaces, rarely ecorticate below *(Anzia)*; algae protococcoid, lower surface nearly nude or more usually covered with rhizinae which rarely anastomose to form a spongy hypothallus *(Anzia* and *Pannoparmelia)*; cyphellae present in *Pseudoparmelia* only. Apothecia circular, sessile to short-stipitate, amphithecium well developed; paraphyses branched or unbranched, often imbedded in a gel; asci 6–8-spored (16–32-spored in *Anzia* and *Candelaria)*; ascospores hyaline, unicellular.

Of the eleven commonly recognized genera of this family, only *Parmelia* and *Pannoparmelia* have been found in the Antarctic.

KEY TO ANTARCTIC SPECIES OF PANNOPARMELIA, PARMELIA, AND PHYSCIA

Rhizinae anastomosing to form a dense spongy hypothallus; laciniae narrow, appressed; ascospores small, subspherical .... PANNOPARMELIA
  Laciniae 0.7–1.0 mm. broad, subdichotomous, tips truncate, white... *P. pellucida*

Laciniae 0.3–0.6 mm. broad, irregularly branched, tips rounded, becoming gray and darkening .... *P. delicata*
Rhizinae not conspicuously anastomosing nor forming a hypothallus; laciniae larger; ascospores ellipsoidal, ovoid or spherical .... *Parmelia*
Cortex of branched hyphae perpendicular to the surface of the thallus, cells more or less isodiametric, often giving the appearance of pseudoparenchyma in both upper and lower cortex .... EUPARMELIA
Laciniae yellow, KOH yellow, verruculose granulose ...... *Parmelia Gerlachei*
Laciniae pale fuscous, KOH–, smooth .... *Physcia fuscella*
Upper cortex appearing pseudoparenchymatous above and often extending to the under-side of the tips of the lobes for a short distance; lower cortex of conglutinate slender periclinal hyphae, or decomposed .... PHYSCIOIDEAE
Thallus sorediose.
Thallus KOH– above.
Thallus pale straw to yellowish, 0.5–1.5 cm.; laciniae 1–2.5 mm. broad; soredia 1 mm., spherical, often eventually covering much of the upper surface; saxicolous .... *Physcia xanthotropa*
Thallus white, blackening, up to 3 cm.; laciniae 5–6 × .5–1 mm., soredia marginal; muscicolous .... *Physcia Leoniae*
Thallus KOH yellowing above.
Soredia confined to the under-side of the tips of the laciniae; medulla KOH– .... *Physcia tribacia*
Soredia scattered on the upper surface of the laciniae.
Margin with long white branched fibrils (cilia) .. *Parmelia leucoblephara*
Margin eciliate.
Laciniae 0.6–0.8 mm., dichotomous, tips truncate, yellowish rarely graying; soredia eroded, common .... *P. variolosa*
Laciniae 0.4–0.5 mm., flabellate, tips rounded, gray and blackening, soredia eroded, rare .... *P. Coreyi*
Laciniae 0.5–1.10 mm., polychotomous, tips dilated, white to bluish gray, soredia spherical .... *Physcia caesia*
Thallus minutely isidiose, chestnut to black in the center, paler at margin; laciniae 0.5–0.8 mm. broad; medulla KOH slightly reddish .... *Parmelia acervata*
Thallus neither sorediose nor isidiose.
Thallus black-margined, straw to white; laciniae 1–2 mm. broad, 5–7 mm. long, tips rounded; KOH– .... *Physcia puncticulata*
Thallus black variegated, yellow tabacine, KOH slightly yellowing; laciniae 0.4–0.6 mm. broad, tips crenulate .... *Physcia tabacina*
Thallus neither black variegated nor black-margined.
Thallus ashy rufescent, pruinose above, KOH– .... *Physcia pulverulenta*
Thallus whitish or grayish.
KOH rufescent; thallus pale olive buff then gray; laciniae 0.2–0.3 mm. .... *Parmelia griseola*
KOH yellow.
Ascospores 10.5–14.5 × 3.5–4.5 μ; thallus gray and darkening; laciniae 0.8–1.0 mm. .... *Parmelia Coreyi*

Ascospores 16–26 × 8–11 μ; thallus white or glaucous; laciniae 1–2(–3) mm. .... *Physcia stellaris* v. *adpressa*

KOH– above.

Laciniae 1–2 mm. broad, tips dilated, ashy, scattered; rhizinae fuscous .... *Physcia disseminata*

Laciniae 0.5–0.7 mm. broad, tips dilated; rhizinae white, nigrescent .... *Physcia inordinata*

Laciniae 0.2–0.4 mm. broad, tips not dilated; rhizinae white .... *Physcia nitescens*

PANNOPARMELIA

PANNOPARMELIA Darbishire, Wiss. Ergebn. Schwed. Südpolar-Exp. 1901–1903. 4[11]: 11. 1912.

Anzia sect. *Pannoparmelia* Müll. Arg., Flora **72**: 507. 1889.

The type species is *P. angustata.* (Pers.) Darb.

Thallus foliose, laciniate, lobes elongate, narrow, appressed; upper cortex fastigiate; algae protococcoid; medulla loosely woven; lower cortex well developed, producing an anastomosing network of rhizinae which form a hypothallus, giving the appearance of *Pannaria.* Apothecia sessile on the upper surface, amphithecium well developed, epithecium amorphous; hypothecium hyaline with algae below; paraphyses imbedded in a gel; asci 8-spored; ascospores small, subspherical, thin-walled. Spermogonia unknown.

At first sight this genus appears to be a small *Pannaria* with a very highly developed brownish black hypothallus, but has protococcoid algae, and a parmelioid apothecium. *P. angustata* (Pers.) Darb. was described from New Zealand, and *P. anzioides* Darb. (*P. Darbishireana* Zahlbr.) from Tierra del Fuego. The well-developed lower cortex, with the anastomosing rhizinae forming a prominent hypothallus, makes it possible to recognize the genus even in the sterile condition.

PANNOPARMELIA **pellucida** Dodge & Baker, sp. nov.

Pl. 63, fig. 417; pl. 64, figs. 418, 421, 422.

Type: Marie Byrd Land, Edsel Ford Range, Lichen Peak, *P. Siple & S. Corey 73-1.*

Thallus ad 1.5 cm. diametro, laciniatus, laciniae 0.7–1.0 mm. latitudine, subdichotome ramosae, subtruncatae, albidus, subpellucidus, minute pruinosus; cortex superior 15 μ crassitudine, pseudoparenchymaticus, 2–3 stratis cellularum pachydermaticarum; algae non visae; medulla 90–100 μ crassitudine, arachnoidea, hyphis

verticalibus 2–3 μ diametro, leptodermaticis, reticulatim dispositis; cortex inferior 20–30 μ crassitudine, hyphis periclinalibus conglutinatis; rhizinae 40–50 μ diametro, hyphis tenuibus longitudinalibus conglutinatis.

Thallus up to 1.5 cm. in diameter, laciniate, laciniae 0.7–1.0 mm. broad, subdichotomously branched, rather truncate, white, subpellucid, minutely pruinose; upper cortex 15 μ thick, pseudoparenchymatous, of 2–3 layers of thick-walled large cells; algae not seen; medulla 90–100 μ thick, arachnoid, of thin-walled vertical hyphae 2–3 μ in diameter, loosely tangled to reticulate; lower cortex 20–30 μ thick, of periclinal hyphae imbedded in a deeply staining gel; rhizinae 40–50 μ in diameter, of gelified slender longitudinal hyphae, anastomosing into a spongy network and forming a hypothallus which extends some distance beyond the laciniae, giving the appearance of a species of *Pannaria.*

It is with some hesitation that we have described this as a new species. The rhizinae and lower portion of the medulla are invaded by a dematiaceous fungus which reaches the upper cortex in one place. It would seem to be an old thallus from which the algae have completely disappeared, and to show no trace of apothecia.

On sericite-orthoclase schist.

Marie Byrd Land: **Edsel Ford Range, Lichen Peak, *P. Siple & S. Corey 73-1,* type.**

Pannoparmelia **delicata** Dodge & Baker, sp. nov.

Pl. 63, fig. 417; pl. 64, figs. 419, 420, 423.

Type: Marie Byrd Land, Edsel Ford Range, Lichen Peak, *P. Siple & S. Corey 73-1.*

Thallus ad 1 cm. diametro, laciniatus, laciniae 0.3–0.6 mm. latitudine, subdichotome vel irregulariter ramosae, apicibus rotundatis, albidus dein griseus et obscurascens; cortex superior 7–10 μ crassitudine, gelifactus amorphusque; algae rarae, protococcoideae, 5–6 μ diametro sub cortice, sparsae; medulla 55–60 μ crassitudine, arachnoideae, hyphis 2–3 μ diametro, reticulatim dispositis; cortex inferior 10–15 μ, gelifactus, hyphis periclinalibus; rhizinae cylindricae, 40–45 μ diametro, hyphis longitudinalibus, 2 μ diametro, conglutinatis, hyalinis, exteris subbrunnescentibus, reticulatim anastomosantes.

Apothecia sessilia, subterminalia?, 160–170 μ diametro, marginata; cortex 5–7 μ, gelifactus; amphithecium 20–25 μ crassitudine, hyphis tenuibus reticulatim dispositis; hypothecium 7–10 μ, hyphis tenuibus periclinalibus, hyalinum, gelifactum; thecium 30 μ altitudine; paraphyses tenues, gelifacti; asci cylindrici; ascosporae

sphericae, unicellulares, 3 μ diametro. Thecium evanescens; soredia subspherica, 30 μ diametro, cellulis 4–6 algarum pseudoparenchymatice corticatis amphithecium implentia.

Thallus up to 1 cm. in diameter, laciniae 0.3–0.6 mm. broad, subdichotomously or irregularly branched, tips rounded, white, then gray and darkening, opaque; upper cortex 7–10 μ thick, deeply staining but gelified and amorphous; algae very rare, protococcoid, 5–6 μ in diameter; medulla 55–60 μ thick, arachnoid, of reticulately arranged hyphae 2–3 μ in diameter; lower cortex 10–15 μ thick, gelified, of periclinal hyphae; rhizinae cylindric, 40–45 μ in diameter, of conglutinate longitudinal hyaline hyphae 2 μ in diameter, outer hyphae browning, anastomosing into a dense network which forms a hypothallus extending beyond the laciniae.

Apothecia sessile and apparently subterminal on the lobes, 160–170 μ in diameter, marginate; cortex 5–7 μ thick, deeply staining and completely gelified; amphithecium 20–25 μ thick, of slender hyphae in a network, much as in the medulla; hypothecium 7–10 μ thick, of slender hyaline periclinal hyphae, gelified; thecium 30 μ tall; paraphyses slender, gelified; asci cylindric, 8-spored; ascospores spherical, unicellular, thin-walled, 3 μ in diameter.

In our material the thecium has largely disappeared and been replaced by a layer of spherical soredia 30 μ in diameter with 4–6 algal cells surrounded by a pseudoparenchyma. The characters of the thecium above reported are from a single portion remaining between two soredia. Even this portion has begun to gelify so that the height of the thecium may be too little. The thallus has apparently been invaded by the same dematiaceous fungus which is invading *P. pellucida* on the same rock, but the invasion is much less severe. There is sometimes a layer of large brownish obovoid cells just below the gelified upper layer (called cortex above). The interpretation is uncertain as the cells are not uniform in distribution. It is possible that they represent the terminal swollen cells of a fastigiate cortex such as has been reported in *P. anzioides*, and the gelified layer is a layer of dead cells so frequent in our Antarctic material. These swollen cells have also been seen

in the apothecium where one would expect cortical cells but here also their distribution is not uniform.

On sericite-orthoclase schist.

MARIE BYRD LAND: Edsel Ford Range, Lichen Peak, *P. Siple & S. Corey 73-1.*

PARMELIA

PARMELIA Acharius, Meth. Lich. 153. 1803.

Imbricaria Acharius, K. Vetensk. Akad. Nya Handl. **15**: 250. 1794; Michaux, Fl. Bor.-Am. **2**: 322. 1803; Lamarck & DeCandolle, Fl. Franç. ed. 3. **2**: 385. 1805.

Physcia S. F. Gray, Nat. Arr. Brit. Pl. **1**: 455. 1821, non Schreber, 1791.

The selection of a type species of this very large and variable genus is very difficult. When originally proposed, it included most of the foliose members of the lecanorine series. Each successive treatment by Acharius removed sections and species to other genera. Of the original species surviving in his last treatment of the genus in 1814, most remain in the genus as it is commonly understood today. If we exclude the doubtful species and the species subsequently taken as types of other genera or closely related to them, e. g., *Omphalodium* Meyen & Flotow, Nova Acta Acad. Leopold. Carolin. **19**: Suppl. 223. 1843, based on *O. pisacomense* Meyen & Flotow, includes *O. hottentotta* (Ach.) Meyen & Flotow; *Parmotrema* Massalongo, Atti. I.R.Ist. Veneto III. **5**: 248. 1860, based on *P. perforata* (Wulfen apud Jacquin) Mass. and including *Parmelia perlata* (Hoffm.) Ach. and *P. caperata* (L.) Ach.; *Pseudoevernia* Zopf, Beih. z. bot. Centralbl. **16**: 124. 1903, based on *P. furfuracea* (L.) Zopf; sect. *Melaenoparmelia* Hue, Nouv. Arch. Mus. IV. **1**: 138. 1899, based on *P. stygia* (L.) Ach. and including *P. olivacea* (L.) Ach.; *Xanthoparmelia* Vainio, Étude Lich. Brésil **1**: 60. 1890, based on *P. conspersa* Ach., etc., and including *P. centrifuga* (L.) Ach., we are left with two groups of four species each. The subgenus *Hypogymnia* includes one group: *P. encausta* (Sm.) Ach., *P. intestiniformis* (Vill.) Ach., *P. lophyrea* Ach., and *P. physodes* (L.) Ach. The remaining four species—*P. omphalodes* (L.) Ach., *P. saxatilis* (L.) Ach., *P.*

scortea Ach., and *P. tiliacea* Ach.—are commonly placed in *Euparmelia* sect. *Hypotrachynae.* A species selected from the latter group would conserve the name for the larger number of species.

We have been unable to consult the original publication cited for *Imbricaria.* Acharius used it as a subgenus in 1798 and abandoned it in all his subsequent treatments. For *Imbricaria* Michaux cites only *I. convexiuscula (Anzia colpodes* (Ach.) Stiznbgr. fide Zahlbr., Cat. Lich. Univ. 6: 276. 1931), although *I. omphalodes* and *I. physodes* are mentioned without description. Lamarck & DeCandolle used it in the modern sense of *Parmelia,* but included some species of Collemaceae and Usneaceae.

Physcia S. F. Gray was based on *P. physodes* (L.) Gray, now placed in *Parmelia* sect. *Hypogymnia,* and *P. diatrypa* (Ach.) Gray, later made the type species of *Menegazzia.*

Thallus foliose, laciniate, lobes rounded, elongate, linear or filiform, appressed or ascending with more or less well-developed rhizinae, the lower surface rarely nude; upper cortex of simple or branched septate hyphae perpendicular to the surface, with small cells, upper surface often isidiose or sorediose; algae protococcoid; medulla loosely woven, occasionally with a central cavity, composed of thin or thick-walled periclinal hyphae; lower cortex usually dark. Apothecia sessile or short-stipitate on the upper surface, disc sometimes perforate; amphithecium well developed; epithecium amorphous; hypothecium hyaline with algae below; paraphyses imbedded in a gel, usually branched and septate; asci 2–8-spored; ascospores hyaline, unicellular, ellipsoidal, ovoid or spherical, thin-walled or with a thickened membrane. Spermogonia immersed in the surface of the thallus or in the amphithecium or ostiole protruding from a wart, spherical to ovoid, wall black above, brown or hyaline below; spermatiophores simple or sparingly branched, spermatia cylindric to fusiform.

The genus may be divided as follows:

Cortex appearing pseudoparenchymatous above and often extending the underside of the lobes for a short distance; lower cortex of compact slender, periclinal hyphae, or decomposed..........................*Physcioideae*

Cortex of branched hyphae perpendicular to the surface of the thallus; cells more or less isodiametric, often giving the appearance of pseudoparenchyma on both upper and lower surfaces.
Nude below, without rhizinae.
Thallus perforate below; laciniae slender; apothecia 6–8-spored; ascospores not over 10 μ.
Medulla excavated.................................... *Hypogymnia*
Medulla solid.................................... *Allantoparmelia*
Thallus perforate above; asci 2–4-spored; ascospores relatively large..... .... *Menegazzia*
Rhizinae scanty; laciniae greenish brown to black; apothecia sessile........ .... *Melaenoparmelia*
Thallus with long coarse rhizinae to almost nude; laciniae slender, usually ascending, gray.................................... *Pseudoevernia*
Central portion of thallus rhizinose, margin nude, smooth but often ciliate; laciniae white, gray or yellowish; apothecia more or less stipitate.... .... *Parmotrema*
Thallus yellow.................................... *Subflavescentes*
Thallus white or gray.................................... *Subglaucescentes*
Thallus completely and densely rhizinose below; rhizinae next the margin often reduced to papillae; laciniae appressed.................. *Euparmelia*
Laciniae yellow.................................... *Xanthoparmelia*
Laciniae white to gray or brownish........................ *Hypotrachynae*
Laciniae di- or seldom trichotomously branched, slender, almost linear, tips truncate or notched.................................... *Sublinearis*
Laciniae irregularly branched, lobes of unequal width.
Tips usually rounded, or notched; apothecia sessile........... *Cyclocheila*
Tips usually more or less ascending; apothecia short-stipitate...... .... *Irregularis*

Several of the above subdivisions have already been segregated as genera but in the absence of a monographic treatment of the whole group the generic segregates have not been widely recognized.

The systematic position of much Antarctic material referred here is doubtful since much of the material is sterile. In view of the structure of the cortex, *Cornicularia lanata* v. *minuscula* Hue, excl. syn. is much better left in *Alectoria* or *Cornicularia* rather than referred to *Parmelia*.

The determination of *Parmelia saxatilis* (L.) Ach. from the Antarctic is extremely doubtful since the material is sterile and no microscopic details of the Antarctic plants are given. *P. quarta* Darb. belongs in *Omphalodium* (see p. 561) rather than in the section *Hypotrachynae* as catalogued by Zahl-

bruckner. *P. Gerlachei* Zahlbr. (*P. antarctica* Vainio non Bitter) belongs in the section *Xanthoparmelia*. *P. acervata* Hue seems more closely related to our species from Marie Byrd Land and is rather aberrant in its cortical structure from either the *Hypotrachynae* where it was placed by its author or the section *Melaenoparmelia* where it is catalogued by Zahlbruckner. Our species approach *Physcia* in the structure of the thallus and would be placed in that genus in the absence of apothecia. Since all the species of *Physcia* so far reported from the Antarctic have been small sterile thalli, it is quite possible that some of them may be found to belong in *Parmelia* when apothecia are found. We have preferred not to transfer them to *Parmelia* but have included members of both genera in the key on p. 584, based largely upon characters observable in the sterile thallus. Two of our own species are sterile but we have preferred to refer them to *Parmelia* in view of their similarity to the structure of our fertile species, recognizing that it may be necessary to transfer them to *Physcia,* should their apothecial characters when discovered, warrant such a transfer.

Parmelia **leucoblephara** Dodge & Baker, sp. nov.

Type: Marie Byrd Land, Edsel Ford Range, Lichen Peak, *P. Siple & S. Corey 73-7.*

Thallus ad 0.8 cm. diametro, laciniae irregulariter ramosae, divaricatae, applanatae subconvexaeve, 0.2–0.3 mm. latitudine apicibus subtruncatis, laeves, albidae, marginibus laevibus cum ciliis longis, ramosis, albis dein fuscis; sorediis granulosis subisidiosisque, marginibus subelevatis; KOH flavescens; rhizinae elongatae, fuscae, non ramosae; cortex superior 15 μ crassitudine, fastigiatus, cellulis ellipsoideis, brunneis, 7–14 × 5.5–7 μ, strato gelifacto 7–8 μ crassitudine tectus; stratum gonidiale 20–30 μ crassitudine, cellulis protococcoideis, 5–7 μ diametro, singulis vel in coloniis parvis; medulla 55–60 μ crassitudine, hyphis tenuibus 1.5–2 μ diametro, laxissime implexis; cortex inferior 30 μ crassitudine, hyphis 1.5–2 μ, subbrunneis, laxe implexis, strato extero cellularum subsphericarum, 5.5–6 μ, brunnearum; rhizinae 40–60 μ diametro, hyphis longitudinalibus, strato extero brunneo. Spermogonia immersa, subspherica, 55–70 μ, murus 7–9 μ crassitudine, cellulis pachydermaticis isodiametricis; spermatiophorae elongatae, tenues; spermatia bacilliformia, recta.

Thallus up to 0.8 cm. in diameter, laciniae irregularly branched, divaricate, flat or somewhat convex, white, smooth,

margins smooth, with long branched cilia, white then fuscous; soredia granulose and subisidiose with somewhat elevated margins; KOH yellowing; rhizinae long, fuscous and unbranched; upper cortex 15 μ thick, fastigiate, cells ellipsoid, brown, 7–14 × 5.5–7 μ, covered by a gelified layer 7–8 μ thick; algal layer 20–30 μ thick, cells protococcoid, 5–7 μ in diameter, single or in small colonies; medulla 55–60 μ thick, of slender hyphae 1.5–2 μ in diameter, very loosely woven; lower cortex 30 μ thick, of brownish hyphae 1.5–2 μ, loosely woven with an outer layer of subspherical brown cells 5.5–6 μ in diameter; rhizinae 40–60 μ in diameter, of longitudinal hyphae with an outer brown layer.

Spermogonia immersed, subspherical, 55 × 70 μ, wall 7–9 μ thick, of isodiametric thick-walled cells; spermatiophores long, slender; spermatia bacilliform, straight.

Growing loose over mosses, *Grimmia Antarctici,* over granodiorite and biotite-sericite and sericite-orthoclase schist.

MARIE BYRD LAND: Edsel Ford Range, Lichen Peak, *P. Siple & S. Corey 73-1, 73-7*, type; Chester Mts., *P. Siple & S. Corey 97A-1;* Mt. Donald Woodward, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff DW-4.*

PARMELIA **variolosa** Dodge & Baker, sp. nov.

Pl. 50, figs. 192–201.

Type: Marie Byrd Land, Edsel Ford Range, Mt. Rea-Cooper, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff R-1.*

Thallus ad 2 cm. diametro, laciniae convexae, 0.6–0.8 mm. latitudine, dichotome ramosae, apicibus truncatis, laeves, pruinosae, primulino-flavae raro sordidescentes; soralia magna, granulosa, KOH addito flavescentia; cortex superior 5–20 μ crassitudine, cellulis isodiametricis laxe dispositis, strato cellularum emortuarum 5–15 μ crassitudine tectus; algae 7–9 μ diametro, protococcoideae, paucae, sparsae; medulla 500–600 μ crassitudine, hyphis 2–4 μ diametro, laxe reticulatimque dispositis; cortex inferior 40–60 μ crassitudine, hyphis obscuris pachydermaticis; rhizinae ad 1100 μ diametro, hyphis obscuris longitudinalibus, exteris pachydermaticis.

Apothecia ad 0.5 mm. diametro, marginata, rufo-brunnea aut grisea, sessilia, rara; amphithecium 50–80 μ crassitudine, cortex 20 μ, decompositus, raro subfastigiatus; parathecium non evolutum; hypothecium 10–20 μ crassitudine, hyalinum, hyphis tenuibus dense reticulatis; thecium 50–60 μ altitudine; paraphyses 1 μ diametro, apicibus subinflatis vaginatis, ad 3.5 μ diametro, recti, hyalini; asci 50–63 × 10–15 μ, elongato-clavati, vaginati; ascosporae octonae, 9–11 × 4.5–6 μ, late ellipsoideae vel subreniformae, hyalinae.

Spermogonia 70 × 90 μ, ampulliformia, murus obscure brunneus, cellulis isodiametricis parvis pachydermaticis; spermatia 1–1.5 μ longitudine, recta, tenuia.

Thallus up to 2 cm. in diameter, laciniae convex, 0.6–0.8 mm. broad, dichotomously branched, tips truncate, smooth, pruinose, primuline yellow rarely graying; soralia large, granular, KOH yellow; upper cortex 5–20 μ thick, rather loosely pseudoparenchymatous, covered by a gelified layer 5–15 μ thick, thicker where the cortex is thin and vice versa; algae 7–9 μ in diameter, protococcoid, few, small, scattered in the upper portion of the medulla which is 500–600 μ thick, of loosely reticulate hyphae 2–4 μ in diameter; lower cortex 40–60 μ thick, of very dark, sometimes black, hyphae, more or less fibrous in arrangement with here and there abundant groups of cut ends of hyphae running at right angles to the others; rhizinae common, up to 1100 μ in diameter, of dark fibrous hyphae with an outer layer identical and continuous with that of the thallus, about 10 μ thick. The tips of the lobes have a cortex thicker than the upper one, about 30–40 μ thick.

Apothecia up to 0.5 mm. in diameter, more or less circular, with a prominent margin, reddish brown to gray and concolorous with the thallus, sessile, very rare; amphithecium 50–80 μ thick, cortex about 20 μ, mostly decomposed, occasionally somewhat fastigiate; parathecium not developed; hypothecium 10–20 μ thick, hyaline, of slender densely reticulate hyphae; thecium 50–60 μ tall; paraphyses about 1 μ in diameter, with slightly enlarged apical cells surrounded by a gelified sheath 3.5 μ in diameter, mostly straight, rarely branched, not darkened; epithecium 5–10 μ thick, light brownish; asci 50–63 × 10–15 μ, elongate-clavate, with a prominent sheath and an umbonate end to the protoplasmic content, 8-spored; ascospores 9–11 × 4.5–6 μ, broadly ellipsoidal to somewhat reniform, hyaline.

Spermogonia frequent, 70 × 90 μ, flask-shaped, with a dark brown wall of thick-walled, small, isodiametric cells; spermatia 1–1.5 μ long, very slender and straight.

On dark greenish gray slate and growing over mosses, *Grimmia Antarctici.*

The apothecia are extremely rare, and it is difficult to establish their identity with the thallus. Apparently in the apothecial regions the thallus enlarges, becomes distorted, and more floccose with an increased algal content (pl. 50, fig. 198).

MARIE BYRD LAND: Edsel Ford Range, Mt. Rea-Cooper, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff R-1*, type; Lichen Peak, *P. Siple & S. Corey 73-1, 73-4;* Skua Gull Peak, *P. Siple & S. Corey 72W-3, 72W-4, 72W-6, 72W-14, 72W-15.*

PARMELIA **Coreyi** Dodge & Baker, sp. nov.

Pl. 50, figs. 202–204.

Type: Marie Byrd Land, Edsel Ford Range, Skua Gull Peak, *P. Siple & S. Corey 72W-3.*

Thallus fragilis, laciniatus, lobis convexis, 0.4–0.5 mm. latitudine, apicibus flabellatis, 0.8–1.0 mm. latitudine, excisis, apicibus lacinularum rotundatis, laevis, pruinosus, raro erosus granulosusque, griseus obscurascensque, KOH addito flavescens; cortex superior 10–20 μ, fastigiatus, cellulis ellipsoideis, 5.5–7 × 4–5 μ, compactioribus quam in *P. variolosa*, exteris obscuris, strato gelifacto 7–10 μ crassitudine tectus; stratum gonidiale 30–35 μ crassitudine, cellulis ad 10 μ diametro, protococcoideis; medulla 700–1000 μ crassitudine, hyphis subbrunneis laxe implexis; cortex inferior 20–30 μ crassitudine, fibrosus, laxior quam in *P. variolosa;* rhizinae 700–1000 μ diametro, ramosae, hyphis densissime compactis longitudinalibus, cortex ad 10 μ crassitudine, cellulis brevibus pachydermaticis obscuris.

Apothecia ad 0.5 mm. diametro, marginata, rara, brunnea, sessilia; hypothecium hyalinum; thecium 45–55 μ altitudine; paraphyses 1–1.5 μ diametro, septati, apicibus subinflatis, vaginatis ad 3.5 μ diametro, brunneis, epithecium 5–10 μ crassitudine, brunneum, gelifactum; asci 42–50 × 10.5–13 μ, late clavati, apice protoplasmatis umbonata, vaginati; ascosporae octonae, 10.5–14.5 × 3.5–4.5 μ, elongato-ellipsoideae aut subreniformes, hyalinae.

Spermogonia 55 × 70 μ, subspherica, murus hyalinus, spermatiophorae crassiores, septatae.

Thallus fragile, laciniae convex, 0.4–0.5 mm. broad, tips flabellate, 0.8–1.0 mm. broad, sinuses excised, tips of lacinulae rounded, smooth, pruinose, rarely eroded, granulose, gray and darkening, KOH yellow; upper cortex 10–20 μ thick, fastigiate, of ellipsoidal cells 5.5–7 × 4–5 μ, loosely packed but much more closely than in *P. variolosa,* upper cells darkened, covered by a gelified layer 7–10 μ thick; algal layer 30–35 μ thick, cells up to 10 μ in diameter, protococcoid, quite abundant; medulla 700–1000 μ thick, of loosely woven hyphae somewhat brownish throughout; lower cortex 20–30 μ, less compact than in *P. variolosa,* only the outer cells darkened, more or less fibrous; rhizinae numerous, 700–1000 μ in diameter, branched, dark brown on the outside, cortex up to 10 μ thick, of dark short thick-walled cells, the rest of densely packed longitudinal hyphae.

Apothecia up to 0.5 mm. in diameter, rarely with a promi-

nent margin, brown, sessile; hypothecium hyaline; thecium 45–55 μ tall; paraphyses 1–1.5 μ in diameter, rarely branched, septate, the terminal cells enlarged, surrounded by a large gelified sheath up to 3.5 μ in diameter, brown at maturity, epithecium 5–10 μ thick, brownish, gelified; asci 42–50 × 10.5–13 μ, broadly clavate, protoplasmic contents with a small umbonate apex, sheath moderately developed, 8-spored; ascospores 10.5–14.5 × 3.5–4.5 μ, elongate-ellipsoidal to subreniform, hyaline.

Spermogonia about 55 × 70 μ, subspherical, the walls not darkened, imbedded in the thallus, spermatiophores thick, closely septate.

Growing over mosses on sandy loam.

Due to the rarity of the apothecia, they were not imbedded and sectioned in this species. All microscopic details are from crushed mounts.

Marie Byrd Land: Edsel Ford Range, Lichen Peak, *P. Siple & S. Corey 73-1;* Skua Gull Peak, *P. Siple & S. Corey 72W-2, 72W-3,* type, *72W-4, 72W-7, 72W-9, 72W-13, 72W-14.*

Parmelia **griseola** Dodge & Baker, sp. nov.

Pl. 50, figs. 205–208.

Type: Marie Byrd Land, Edsel Ford Range, Skua Gull Peak, *P. Siple & S. Corey 72W-3.*

Thallus ad 1 cm. diametro, laciniae lineares, convexae, dichotome ramosae, 0.2–0.3 mm. latitudine, pruinosae erosaeque, pallide olivaceo-alutaceae dein griseae obscurascentesque, KOH addito rufescentes; cortex superior 20–40 μ crassitudine, pseudoparenchymaticus, cellulis circa 4 μ diametro, leptodermaticis, strato gelifacto 5–10 μ crassitudine tectus; stratum gonidiale 30–50 μ crassitudine, cellulis protococcoideis, ad 10 μ diametro; medulla 50–80 μ crassitudine, hyphis 2 μ diametro, laxe implexis, densioribus ad corticem inferiorem; cortex inferior 20–30 μ crassitudine, fibrosus, cellulis 1–3 μ diametro, exteris obscurascentibus; rhizinae ramosae, 500–800 μ diametro, cellulis 1.5–2 × 20 μ, cortex 5 μ crassitudine, cellulis 2–4 × 4.5–9 μ. Sterilis.

Thallus up to 1 cm. in diameter, laciniae linear, convex, dichotomously branched, 0.2–0.3 mm. broad, pruinose and eroded, pale olive buff then graying and darkening, KOH rufescent; upper cortex 20–40 μ thick, pseudoparenchymatous, in some places the outer cells darkened, in others not, of thin-walled cells about 4 μ in diameter, covered by a gelified layer

5–10 μ thick over the darkened areas, less developed over the lighter areas; algal layer up to 30–50 μ thick, cells up to 10 μ in diameter, protococcoid, abundant, some imbedded in the cortex; medulla 50–80 μ thick, of slender hyphae about 2 μ in diameter, loosely woven, becoming more or less fibrous at the junction with the lower cortex which is 20–30 μ thick, fibrous, hyphae 1–3 μ in diameter, only the outer ones darkened; rhizinae frequent, branched, 500–800 μ in diameter, of dark cells 1.5–2 × 20 μ, longitudinally arranged, covered by a cortex about 5 μ thick of short, thick-walled dark cells 2–4 × 4.5–9 μ, progressively longer and thinner within. Sterile.

On dark greenish gray slate and growing over mosses on sandy loam.

MARIE BYRD LAND: Edsel Ford Range, Skua Gull Peak, *P. Siple & S. Corey 72W-3*, type, *72W-9*, *72W-15*.

USNEACEAE

Thallus fruticose, erect, prostrate or pendent, attached to the substrate by a hapteron, radiate, corticate, with longitudinal hyphae (in *Alectoria)* or more usually a palisade of pseudoparenchyma; algae *Protococcus;* medulla dense and horny to cartilaginous or arachnoid, of longitudinal hyphae. Apothecia circular, plane or saucer-shaped, sessile or stalked; amphithecium well developed; asci 1–8-spored; ascospores hyaline or rarely brown, unicellular to muriform, thin-walled.

KEY TO ANTARCTIC GENERA

Cortex strengthened by strands of mechanical tissue; medulla arachnoid; spores 2-celled .... *Ramalina*
Medulla uniform, arachnoid or horny-cartilaginous.
  Cortex of longitudinal hyphae; thallus hollow .... *Alectoria*
  Cortex a palisade of pseudoparenchyma, chondroid axis well developed and central.
    Thallus low, podetiiform to coralloid .... *Siphula*
    Thallus fruticose, radial in structure; medulla easily separable from the cortex .... *Usnea*

Only *Alectoria* and *Usnea* sect. *Neuropogon* have been found in our region; the other genera are represented by one or two species each in the Antarctic Archipelago.

ALECTORIA

ALECTORIA Acharius, Lichenogr. Univ. 120. 1810.

The type species was not designated. Since all the species of Acharius' treatment have been reduced or transferred elsewhere, except *A. jubata* (L.) Ach. and *A. sarmentosa* Ach., and since the former was taken as the type of *Bryopogon* Link, which is often considered a separate genus, Clements & Shear (Gen. Fung. 322. 1931) chose as a type *A. sarmentosa* Ach. as it belongs in the section *Eualectoria* Th. Fries.

Thallus pendulous, prostrate or somewhat erect, attached by a hapteron, round or somewhat flattened, seldom angular, radiate, often black; cortex horny, of longitudinal gelified hyphae; algae *Protococcus*; medulla of longitudinal hyphae, center usually hollow or arachnoid; pseudocyphellae or soralia frequent. Apothecia lateral on short branches; amphithecium usually well developed, margin naked or ciliate, sessile or almost stalked, saucer-shaped, absent in our species; disc brown to black; hypothecium hyaline, resting on the algal layer; paraphyses branched and anastomosing; asci 4–8-spored; ascospores unicellular, ellipsoid, hyaline or brown, thin-walled. Spermogonia immersed in small warts, spermatiophores little-branched, septate; spermatia short, straight, somewhat thickened at each end.

The genus is usually divided into two sections sometimes recognized as genera: *Bryopogon,* thallus bright or dark, medulla hollow in the center, asci 8-spored, ascospores hyaline; and *Eualectoria,* thallus not black, medulla arachnoid, asci 4-spored, spores brown. While the species so far reported from Antarctica are sterile, they seem to belong in section *Bryopogon* as does our single fertile species.

Since *A. antarctica* is unique in the family in lacking an amphithecium, it might be considered the type of a new genus and family in the lecideine series of families, representing a higher state of development from the Phyllopsoraceae. In all of its other characters it agrees with *Alectoria* sect. *Bryopopogon,* and we prefer to leave it in this genus as is done in case of the few species of *Stereocaulon* of the section *Lecanocaulon* with lecanorine apothecia in an otherwise lecideine family.

KEY TO ANTARCTIC SPECIES

Thallus pale rufous, base fuscous, erect, flattened, variously long-perforate, granulose-sorediate; ecorticate; algae 10–20 (–28) μ............*A. corymbosa*

Thallus black, prostrate, terete, not perforate; corticate, esorediose; algae 6–18 μ.

- Branches erect or incurved, ramuli spinulose, surface smooth or nodulose; cortex 10–20(–30) μ; hyphae 8–18 μ............................*A. nigerrima*
- Branches dichotomous or variously divaricate and intricate.
  - Ramuli capilliform, fibrillose; cortex 20–40 μ; hyphae 10–12 μ.....*A. intricata*
  - Ramuli obtuse or acute but never capilliform; cortex 10–15 μ.....*A. antarctica*
  - Tips short-digitate; cortical hyphae 4–6 μ......................*A. minuscula*

ALECTORIA **antarctica** Dodge & Baker, sp. nov.

Pl. 51, figs. 209–216.

Type: Marie Byrd Land, Edsel Ford Range, Mt. Rea-Cooper, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff R-1*

Thallus radiatus, ramosissimus, dichotomus, apicibus obtusis subacutisve, non attenuatis, niger; cortex 10–15 μ crassitudine, irregularis, hyphis longitudinalibus pachydermaticis, exteris nigris, interis hyalinis, 3–5 μ diametro; algae ad 8 μ diametro, protococcoideae, rarae, sparsae; medulla 100–200 μ diametro, centro aperto, sine axi chondroideo, hyphis 2 μ diametro, longitudinaliter aut irregulariter implexis.

Apothecia ad 0.7 × 0.45 mm., sessilia, nigra, convexa, carbonacea; amphithecium deest; parathecium 20–25 μ crassitudine, obscure fuscum, pseudoparenchymaticum; hypothecium hyalinum vel dilute brunneum; thecium 35–40 μ altitudine; paraphyses 1 μ diametro, pauci, septati, non capitati, ramosi vel non, hyalini; epithecium 10–15 μ, hyalinum, KOH–; asci 32–36 × 13–15 μ, late clavati, vaginati; ascosporae octonae, 6–7 × 3–3.5 μ, ellipsoideae, hyalinae.

Thallus radiate, much branched, dichotomous, the ends blunt to pointed but never extremely attenuated, entirely black; cortex 10–15 μ thick, irregular, of longitudinal hyphae appearing pseudoparenchymatous in cross-section, thick-walled, outside black becoming progressively lighter toward the center, 3–5 μ in diameter; algae up to 8 μ in diameter, protococcoid, few, scattered; medulla 100–200 μ in diameter, the center open and lacking a chondroid axis, of irregularly woven hyphae about 2 μ in diameter, mostly longitudinal, sometimes amorphous.

Apothecia up to 0.7 × 0.45 mm., black, sessile, convex, carbonaceous; amphithecium lacking; parathecium 20–25 μ thick, dark fuscous, pseudoparenchymatous, merging laterally with the thalline cortex; hypothecium hyaline to pale brownish; thecium 35–40 μ tall; paraphyses about 1 μ in diameter, very

few, septate, branched or unbranched, heads scarcely expanded, not darkened; epithecium 10–15 μ, hyaline, KOH–; asci 8-spored, 32–36 × 13–15 μ, broadly clavate, with a prominent gelified sheath; ascospores 6–7.5 × 3–3.5 μ, ellipsoidal, hyaline.

On coarse-grained leucogranite, granodiorite, pink granite, deep olive-buff granite, sandy loam, biotite-sericite-orthoclase schist, and fine-grained dike.

KING EDWARD VII LAND: Rockefeller Mts., Mt. Helen Washington, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff HW-2, HW-6, HW-9, HW-10, HW-13, HW-14.*

MARIE BYRD LAND: Edsel Ford Range, Mt. Rea-Cooper, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff R-1*, type, *R-4, R-7;* Mt. Grace McKinley, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff McK-5, McK-6, McK-10;* Mt. Corey, *P. Siple & S. Corey 112E-2;* Haines Mts., *P. Siple & F. A. Wade H-2;* Lichen Peak, *P. Siple & S. Corey 73-1, 73-2, 73-6;* Skua Gull Peak, *P. Siple & S. Corey 72W-11, 72W-12, 72W-13, 72W-14;* Chester Mts., *P. Siple & S. Corey 97A-1;* Mt. Donald Woodward, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff DW-5;* Mt. Stancliff, *P. Siple & S. Corey 72A-1.*

S. VICTORIA LAND: Queen Maud Mts., Durham Point at northeast portal of Thorne Glacier, *Q. A. Blackburn, R. S. Russell Jr. & S. D. L. Paine QM-5.*

USNEA

USNEA Wiggers, Primit. Fl. Holsat. 90. 1780.

The type species is *Usnea florida* (L.) Wigg.

Thallus fruticose or filamentous, very rarely of a single branch, usually of several compound branches, dichotomous or subdichotomous, more rarely sympodially branched, from 1 cm. to 7 m. or more long, erect, pendulous or prostrate, base attached to the substrate; branches thicker at the base, thinning very much toward the apex, 0.2–7 mm. thick, terete, angled or longitudinally sulcate, foveolate and scrobiculate, smooth or tuberculate, verrucose or spinuliferous, continuous, areolate or annulate; cortex coriaceous or somewhat spongy, of densely woven, thick-walled, conglutinate hyphae, in a few species almost evanescent on the primary branches; algae *Protococcus;* medulla distinct although often thin, of thin-walled hyphae, very rarely with scattered colonies of algae; chondroid axis single, percurrent, of longitudinal thick-walled hyphae usually very solid, rarely lacerate with a loosely woven center.

Apothecia lecanorine, constricted at the base, lateral, rarely subterminal or terminal, margin evanescent or indistinct, nude or ciliate; asci subcylindric or slightly inflated; spores typically 8 per ascus, simple, hyaline, ellipsoidal, epispore distinct; paraphyses conglutinate, septate, branched, epithecium with distinct granules. Spermogonia rarely present, pale or slightly darkened, immersed in tubercles; spermatia straight with one end slightly thicker.

The genus is divided into six subgenera of which only *Neuropogon,* sometimes recognized as a genus, is typically Antarctic. All its species are confined to the Southern Hemisphere except *U. sulphurea,* which ranges from Patagonia northward in elevations above 3000 m. in the American tropics to the Arctic.

NEUROPOGON

NEUROPOGON Nees & Flotow, Linnaea 9: 496. 1835, pr. p.

Usnea sect. *Neuropogon* Mont. ap. Gay, Hist. Fis. Polit. Chile, Bot. 8: 67. 1852, pr. p.

Usnea subgenus *Neuropogon* Motyka, Lich. Gen. Usnea Stud. Monogr. Syst. 1: 18. 1936.

Thallus short, not reaching 10 cm., fruticose, erect, branched, almost wholly saxicolous, sulphur yellow, orange, or orange red, tips and cilia of apothecia commonly black or whole thallus black or black variegated. Apothecia terminal or lateral, eciliate or rarely ciliate.

KEY TO ANTARCTIC SPECIES

Thallus sorediate, usually sterile.
  Soralia eroded, not in tubercles; thallus usually smooth except for soredia.. .... *U. antarctica*
  Soralia in tubercles, not conspicuously eroded.
    Thallus foveolate to rugose.. *U. frigida*
    Thallus papillate.. *U. granulifera*
Thallus not sorediate, usually fertile, grossly tuberculate-papillate.
  Thallus almost eciliate, tips rather thick, usually fasciate; medulla fairly dense, KOH almost negative, axis horny or chondroid and subpellucid, then slightly fuscous and glassy.................................. *U. fasciata*
  Thallus tips frequently divaricate-branched and appearing ciliate, slender; medulla thin, rather loose, axis opaque, white but not horny..... *U. strigulosa*

USNEA ANTARCTICA DuRietz, Svensk Bot. Tidskr. **20**: 90, 93. 1926. Pl. 51, figs. 217–222.

Neuropogon Taylori Blackman, Rept. Coll. Nat. Hist. Antarctic Voy. Southern Cross 1898–1900. 320. 1902, non Hook. f. & Taylor, London Jour. Bot. **3**: 657. 1844.

Usnea sulphurea f. *sphacelata* Th. Fr., Nyt Mag. Naturvidensk. **40**: 208. 1902, non *Usnea sphacelata* R. Brown, Capt. Parry's Voy. Nat. Hist. Suppl. Append. cccvii. 1824.

Neuropogon melaxanthum Darbishire, Nat. Antarct. [Discovery] Exp. Nat. Hist. **5**: 7. 1910; Brit. Antarct. [Terra Nova] Exp. Bot. 58. 1923, excl. syn.

Type: South Victoria Land, Geikie Land, 71° 40′ S., 170° E., Admiralty Range, 700 m., *C. E. Borchgrevink,* in Bot. Mus. Univ. Upsala.

Thallus erect or prostrate, fruticose, 3–5 cm. tall, sparingly branched, eramulose, rigid, servediose, straw-color, yellowing, tips black or with black bands, or completely blackened, smooth or somewhat shining; base thick, up to 1.5 mm., rigid and firm, sparsely sympodially or dichotomously branched above, branches slightly attenuate at the base and subulate-attenuate at the tips, usually almost simple or branched below the tips, terete, glabrous, shining, smooth or very indistinctly papillate above, sometimes subfoveolate, lateral branches rare, somewhat constricted at the base, ascending, appressed; cortex thin, about 60 μ thick, almost horny, yellow without, of fastigiate pseudoparenchyma, cells thin-walled, up to 7 μ in diameter; algae protococcoid, cells up to 8 μ in diameter, scattered in the medulla which is thin, 80–100 μ, dense, white, KOH–, of smooth hyphae 1.5–3.5 μ in diameter, branched and anastomosed, irregularly woven in a close network, denser next the cortex, looser next the medulla; chondroid axis about 450 μ, horny, slightly fuscous, of closely packed, longitudinal hyphae 1 μ in diameter, thin-walled, cells 25–30 μ long.

Sterile. Soredia frequent in the upper portions, granulose-farinose, white or finally blackened, soralia deeply eroded, or at least not in tubercles.

Growing on granodiorite, sericite schist, and pink granite.

MARIE BYRD LAND: Edsel Ford Range, Mt. Grace McKinley, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff McK-1;* Haines Mts., *P. Siple & F. A. Wade H-3;* Skua Gull Peak, *P. Siple & S. Corey 72W-10, 72W-18;* Mt. Corey, *P. Siple & S. Corey 112E-2.*

KING EDWARD VII LAND: Rockefeller Mts., Mt. Helen Washington, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff HW-6, HW-13.*

S. VICTORIA LAND: Geikie Land, Admiralty Range, 700 m., 71° 40′ S., 170° E., *C. E. Borchgrevink.* Motyka also cites 71° 30′ S., 300 m., *C. E. Borchgrevink;* Cape Adare, *Scott;* Cape Sustruzi, Evans Cove, Brit. Antarct. [Terra Nova] Exp., *Scott;* Darbishire adds. Mt. Terror, Nat. Antarct. [Discovery] Exp., *E. A. Wilson,* and Cape Royds, 500 m., *H. T. F.*

USNEA **frigida** Dodge & Baker, sp. nov. Pl. 51, figs. 223–225.
Type: Marie Byrd Land, Edsel Ford Range, Mt. Rea-Cooper, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff R-1.*

Thallus erectus aut prostratus, fruticosus, 3–5 cm. altitudine, ramosus, eramulosus, rigidus, nitidus, niger, raro basi flavus, laevis, ad 0.7 mm., apicibus non attenuatis, teres, glaber, rugosus aut foveolatus, non dichotome ramosus, ramis non basi attenuatis, divaricatis; cortex 20–30 μ crassitudine, obscurus vel niger extus, dilutior intus, cellulis 4–6 μ diametro, isodiametricis; algae protococcoideae, ad 10 μ diametro, sub cortice in medulla sparsae; medulla 50–60 μ crassitudine, hyphis laxissime implexis, pachydermaticis, 2–4.5 μ diametro, ramosis anastomosantibusque; axis chondroideus ellipticus, 60 × 80 μ, hyphis longitudinalibus, densissimis, hyalinis.

Soralia tuberculata, hemispherica, raro longitudinaliter elongata vel irregularia, non erosa, nigra juventute dein sordide grisea subflavidave.

Thallus erect or prostrate, fruticose, 3–5 cm. tall, branched, eramulose, rigid, shining, black, rarely yellow at the smooth base, up to 0.7 mm. in diameter, tips acute but not attenuate, terete, glabrous, rugose or foveolate, not dichotomously branched, divaricate, branches not attenuate at the base; cortex 20–30 μ thick, dark or black on the outside, lighter within, pseudoparenchymatous, cells 4–6 μ in diameter; algae protococcoid, up to 10 μ in diameter, scattered in the medulla below the cortex; medulla 50–60 μ thick, of loosely woven thick-walled hyphae 2–4.5 μ in diameter, branched and anastomosing; chondroid axis elliptic in cross-section, 60 × 80 μ, of densely packed, longitudinal hyaline hyphae.

Soralia tuberculate, hemispheric, rarely longitudinally elongate or irregular, not eroded, black when young, becoming dirty gray or yellowish.

On coarse pink leucogranite, sericite-orthoclase schist, orthoclase-sericite-siderite schist, and fine-grained dike, also sandy loam.

This species seems intermediate between *U. antarctica* DR. and *U. granulifera,* the branches being more foveolate than the former and not papillate as in the latter. The soralia are close to the latter, which has been reported from the Graham Land Archipelago, South Victoria Land, 71° 18′ S., Heard Island (Deutsch. Südpol. Exp.), and Kerguelen.

KING EDWARD VII LAND: Rockefeller Mts., Mt. Helen Washington, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff HW-2, HW-7, HW-10, HW-11, HW-15, HW-17, HW-18.*

MARIE BYRD LAND: Edsel Ford Range, Mt. Grace McKinley, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff McK-1, McK-5, McK-6, McK-10;* Mt. Donald Woodward, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff DW-1, DW-2;* Mt. Rea-Cooper, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff R-1,* type, *R-2, R-3;* Lichen Peak, *P. Siple & S. Corey 73-1;* Skua Gull Peak, *P. Siple & S. Corey 72W-7, 72W-10, 72W-18;* Mt. Corey, *P. Siple & S. Corey 112E-1.*

BLASTENIACEAE

Thallus crustose, uniform, effigurate, small-foliose or dwarf-fruticose, attached to the substrate by hyphae of the prothallus or of the medulla, or by rhizinae in *Xanthoria,* heteromerous, rarely homoeomerous; ecorticate or fastigiate-corticate, the palisade sometimes forming a pseudoparenchyma, rarely corticate below (in *Xanthoria, Gasparrinia,* and *Kuttlingeria);* algae *Protococcus.* Apothecia round, sessile or immersed, either biatorine, lecideine, or lecanorine, usually with algal layer beneath the hypothecium; epithecium granular or powdery, usually containing chrysophanic acid which is colored purple or violet by KOH; paraphyses simple, septate, tips usually thickened; asci normally 8-spored; ascospores hyaline, thick-walled, polaribilocular (except in *Protoblastenia, Fulgensia,* and *Polycauliona Charcoti).*

KEY TO ANTARCTIC GENERA

Apothecia biatorine, but algae may occur beneath the hypothecium.
  Spores unicellular. . . . . *Protoblastenia*
  Spores 2-celled.
    Thallus crustose, uniform, ecorticate. . . . . *Blastenia*

Thallus effigurate, corticate .... *Kuttlingeria*
Thallus fruticose .... *Lethariopsis*
Spores 4-celled; tropical and subtropical .... *Xanthocarpia*
Apothecia lecideine; thallus crustose, uniform .... *Huea*
Apothecia lecanorine.
Spores unicellular.
Thallus effigurate; mountains of temperate zone .... *Fulgensia*
Thallus dwarf-fruticose .... *Polycauliona Charcoti*
Spores polaribilocular.
Thallus uniform, usually ecorticate .... *Pyrenodesmia*
Thallus effigurate, usually corticate .... *Gasparrinia*
Thallus dwarf-fruticose .... *Polycauliona*
Thallus small-foliose, corticate below with rhizinae .... *Xanthoria*
Spores 3-celled, protoplasts nearly spherical, connected by isthmi; mostly tropical .... *Triophthalmidium*

We have considered *Xanthoria* is better placed in the Blasteniaceae rather than in the Teloschistaceae, since its structure agrees much more closely with this family than with *Teloschistes.* Also there are several transitional species. *Lethariopsis* of the Antarctic Archipelago seems to be a more highly developed genus analogous to *Polycauliona* in the lecanorine series.

PROTOBLASTENIA

PROTOBLASTENIA Steiner, Verh. Zool.-Bot. Ges. Wien **61**: 47. 1911.

Protoblastenia Zahlb. in Engler & Prantl, Die Nat. Pflanzenfam. I. 1*: 226. 1907 (as subgenus of *Blastenia).*

The type species is *P. rupestris* (Scopoli) Steiner.

Thallus crustose, uniform, ecorticate; algae *Protococcus.* Apothecia sessile or immersed, light or dark with well-developed parathecium; hypothecium light or dark; paraphyses simple, asci 8-spored; ascospores hyaline, unicellular. Spermatiophores closely septate, budding off short straight spermatia (arthrosterigmata of Nylander, endobasidial type of Steiner).

The species of this genus are separated from *Lecidea* sect. *Biatora* and *Lecanora* on the production of chrysophanic acid and the structure of the spermogonia.

PROTOBLASTENIA **flava** Dodge & Baker, sp. nov.

Pl. 52, figs. 226–229.

Type: King Edward VII Land, Rockefeller Mts., Mt. Helen

Washington, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff HW-8.*

Thallus granulosus, gelifactus madefactus, ceraceo-flavus vel primulino-flavus, KOH immutatus; cortex deest vel paucis cellulis fastigiatis lateraliter distributis; algae protococcoideae in coloniis parvis a cellulis compactis circumdatis, laxe dispositis insuper pluribus sed in thallo late dispositis; medulla reticulata, funiculis hypharum intertexta; stratum basale densius, paucis cellulis fastigiatis obscuris.

Apothecia ad 1.50 mm. diametro, circularia, convexa, laevia, sparsa vel gregaria, ceraceo-flava vel thallo immerso ochracea; parathecium ad 50 μ crassitudine, bene evolutum, hyphis minutissimis verticalibus densissimis gelifactis; hypothecium ad 75 μ crassitudine, hyalinum, hyphis ut in parathecio, pedem aut stipitem ad 150–200 μ longitudine, 100 μ latitudine inferne formans; thecium ad 150 μ altitudine; paraphyses 1 μ diametro, apicibus 1–3 μ diametro, septati, ramosi vel non ramosi, evaginati, epithecium ad 10 μ crassitudine, dilute brunneum, gelifactum; asci 38–67 × 8–16 μ, elongati, clavati, apicibus umbonatis, insuper vaginatis; sporae octonae, 9–13 × 3.5–6.5 μ, unicellulares, ellipsoideae vel raro subreniformes, centro subconstrictae.

Non-assimilative portions not represented; assimilative portions well developed over areas of several centimeters or reduced to scattered fragments on rocks, about mosses or gravel and debris, granulose, gelified when moist, wax yellow to primuline yellow; no reaction with KOH; cortex not developed or with occasional dark fastigiate strands on the sides; algae protococcoid in small colonies surrounded by compact hyphal cells, the individual masses loosely or not connected with the rest of the thallus, better distributed in the upper portion but occurring deep in the thallus; medulla open reticulate, the net composed of closely united strands of hyphae; basal portions somewhat denser with occasional dark fastigiate cells at the edges.

Apothecia up to 1.50 mm. in diameter, more or less circular, convex, smooth, scattered or gregarious, wax yellow to yellow ochre; parathecium up to 50 μ thick, well developed, of very minute dense, vertical, gelified hyphae; hypothecium up to 75 μ thick, hyaline, similar in structure to that of the parathecium, growing downward into a foot or stipe about 150–200 μ tall and 100 μ broad at the base; thecium up to 150 μ tall; paraphyses 1 μ in diameter, gradually expanding to the usually inflated tips 1–3 μ in diameter, septate, branched or unbranched, without a sheath, epithecium up to 10 μ thick, light brown, gelified; asci 38–67 × 8–16 μ, 8-spored, elongate-clavate, tips umbonate with a

prominent sheath above; ascospores 9–13 × 3.5–6.5 μ, 1-celled, ellipsoid to ovoid or sometimes slightly reniform, slightly constricted in the center.

Growing over mosses and sandy loam or on coarse-grained pink or greenish granite, granodiorite, and orthoclase-sericite-siderite schist.

King Edward VII Land: Rockefeller Mts., Mt. Helen Washington, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff HW-2, HW-3, HW-6, HW-7, HW-8*, type, *HW-9, HW-10, HW-12, HW-13, HW-15, HW-18.*

Marie Byrd Land: Edsel Ford Range, Mt. Rea-Cooper, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff R-2;* Mt. Stancliff, *P. Siple & S. Corey 72A-1;* Skua Gull Peak, *P. Siple & S. Corey 72W-7, 72W-13;* Lichen Peak, *P. Siple & S. Corey 73-3, 73-7, 73-13;* Chester Mts., *P. Siple & S. Corey 97A-1.*

Protoblastenia **alba** Dodge & Baker, sp. nov.

Pl. 52, figs. 239–245.

Type: Marie Byrd Land, Edsel Ford Range, Mt. Donald Woodward, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff DW-5.*

Thallus non assimilans male evolutus, paucis funiculis cellularum nigrarum; thallus assimilans crustosus, ad 1.85 mm. diametro aut areolatus in funiculis longis albus; cortex superior ad 10 μ crassitudine, fastigiatus, cellulis exteris obscuris, ad 5 μ diametro, cum strato cellularum emortuarum 4–5 μ crassitudine; algae protococcoideae, catervis parvis per totum thallum dispersis, densioribus sub apothecio; medulla ad 450 μ crassitudine, hyphis tenuibus, 1–2 μ diametro, laxe reticulatimque dispositis; cortex inferior non bene evolutus, paucis cellulis isodiametricis fuscis.

Apothecia ad 1.0 × 0.65 mm. metientes, irregulariter ellipsoidea maturitate, subspherica juventute, pulvinata, sessilia, immarginata, lecideina, nigra, non nitida; amphithecium non evolutum; parathecium 10–30 μ crassitudine, cortici simile sed cellulis minoribus, ad 2 μ diametro, hyalinum; hypothecium circa 10 μ crassitudine, hyphis periclinalibus tenuibus, hyalinum; thecium 40–50 μ altitudine; paraphyses 1 μ, capitibus 2 μ diametro, subobscuris; epithecium 5–10 μ crassitudine, KOH addito virescens; asci 35–44 × 10–13 μ, tenues, clavati, vaginati; ascosporae octonae, 7–9 × 3–3.5 μ, ellipsoideae, raro subreniformes, apicibus obtusis, hyalinae.

Non-assimilative portion poorly developed, consisting of a few strands of black cells; assimilative portion in small crustose patches up to 1.85 mm. in diameter, or areolate and spread out in long scant strands, pure white, the areolae sometimes outlined by scattered black non-assimilative tissues; upper cortex about 10 μ thick, fastigiate, the outer cells darkened but not very thick-walled, up to 5 μ in diameter, the outer surface covered by a layer of dead cells 4–5 μ thick; algae up to 9 μ in diam-

eter, protococcoid, scattered in small groups throughout the thallus and more or less massed below the apothecium; medulla up to 450 μ thick, of slender hyphae 1–2 μ in diameter, loosely reticulate; lower cortex not differentiated except for loose strands of fuscous isodiametric cells.

Apothecia measuring up to 1.0 × 0.65 mm., irregularly ellipsoidal at maturity, subspherical when young, pulvinate, sessile, never concave or marginate (sometimes a faint white margin can be seen in young stages), lecideine, black, not shining; amphithecium absent; parathecium 10–30 μ thick, cells differing from the cortex only in size, cells up to 2 μ, hyaline; hypothecium about 10 μ thick, of closely woven, slender hyphae, hyaline, tapering laterally then expanding above into the parathecium; thecium 40–50 μ tall; paraphyses 1 μ in diameter, somewhat greater above, expanding abruptly to a head 2 μ in diameter, slightly darkened on the outer surface, epithecium 5–10 μ thick, green with KOH; asci 35–44 × 10–13 μ, slender, clavate, with a prominent sheath, 8-spored; ascospores 7–9 × 3–3.5 μ, ellipsoidal, rarely subreniform, ends blunt, hyaline, unicellular.

On biotite-sericite and sericite-orthoclase schist.

Marie Byrd Land: Edsel Ford Range, Mt. Donald Woodward, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff DW-5*, type; Lichen Peak, *P. Siple & S. Corey 73-1.*

Protoblastenia **aurea** Dodge & Baker, sp. nov.
Pl. 52, figs. 230–238.

Type: Marie Byrd Land, Edsel Ford Range, Skua Gull Peak, *P. Siple & S. Corey 72W-13.*

Thallus assimilans ad 1.5 × 2.5 mm., granulosus vel crustosus, mollior madefactus, cremeus vel subalutaceus; cortex 10–20 μ crassitudine, amorphus, cellulis emortuis, raro paucis cellulis obscuris isodiametricis, sparsis aut stratum ad 30 μ crassitudine interius gignentibus; algae ad 17 μ diametro, protococcoideae, catervis densis per totum thallum sparsae vel in strato gonidiale 30–60 μ crassitudine; medulla ad 600 μ crassitudine, hyphis 1 μ diametro, dense basaliter laxius contexta; cortex inferior non evolutus aut paucis cellulis obscuris isodiametricis sparsis.

Apothecia ad 1.5 mm. diametro, irregulariter circularia, plana aut repanda, margine subcrenulata, aurantiaca thallo obscuriora, sparsa vel gregaria, sessilia; amphithecium non evolutum; parathecium 20–40 μ crassitudine, hyalinum, cellulis isodiametricis leptodermaticis, 2–3 μ diametro; hypothecium 20–30 μ, hyalinum, hyphis dense contextum; algae abundantes sub hypothecio; thecium 40–70 μ altitudine;

paraphyses 1 μ diametro, apicibus ramosis, septati, vaginati; epithecium ad 10 μ crassitudine, hyalinum, KOH–; asci 40–50 × 11–15 μ, clavati, vaginati, apicibus obtusis; ascosporae octonae, 9–12 × 2–4 μ, graciles, ellipsoideae vel subreniformes, apicibus obtusis, raro subacutis, hyalinae.

Spermogonia 60–80 μ altitudine, immersa; murus compactus, hyalinus, ostiola obscure brunnea, gelifacta; spermatia brevia, filiformia.

Assimilative thallus in areas up to 1.5 × 2.5 mm., granulose to crustose, softer when moistened, cream white to dull tan; cortex 10–20 μ, amorphous, of dead cells (decomposed *sensu* Hue), occasionally with a few isodiametric dark cells on the inside of the amorphous layer, scattered or forming a layer up to 30 μ thick; algae up to 17 μ in diameter in dense masses throughout the thallus or in a layer 30–60 μ thick below the cortex; medulla up to 600 μ thick, of slender hyphae 1 μ in diameter, closely woven with denser strands especially surrounding the larger groups of algae, basally becoming more open reticulate; basal cortex not differentiated or with a few scattered, dark, isodiametric cells.

Apothecia up to 1.5 mm. in diameter, irregularly circular, flat to repand, with a slightly crenulate margin, yellow-orange, darker than the thallus, scattered or gregarious, sessile; amphithecium absent; parathecium 20–40 μ thick, of hyaline isodiametric cells slightly larger next the surface, thin-walled, 2–3 μ in diameter; hypothecium 20–30 μ thick, hyaline, of densely woven slender hyphae and algae abundant below the hypothecium; thecium 40–70 μ tall; paraphyses about 1 μ in diameter, scarcely expanding upwards, tips simple, usually freely branched, septate with a thin sheath; epithecium about 10 μ thick, hyaline, KOH–; asci 40–50 × 11–15 μ, clavate, with a conspicuous sheath, ends blunt, 8-spored; ascospores 9–12 × 2–4 μ, slender, ellipsoidal to subreniform, ends blunt or rarely more pointed, hyaline.

Spermogonia 60–80 μ tall, immersed, ostiole slightly protruding; wall compact, hyaline except at the ostiole where it is dark brown and somewhat gelified; spermatia short-filiform.

On weathered coarse-grained pink granite, dark greenish gray slate, and the dark dyke of Mt. Grace McKinley.

King Edward VII Land: Rockefeller Mts., Mt. Helen Washington, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff HW-2, HW-3, HW-12, HW-13.*

Marie Byrd Land: Edsel Ford Range, Mt. Grace McKinley, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff McK-8;* Skua Gull Peak, *P. Siple & S. Corey 72W-13,* type, *72W-15, 72W-18.*

Protoblastenia **citrinigricans** Dodge & Baker, sp. nov. Pl. 52, figs. 246–249.

Type: S. Victoria Land, Queen Maud Mts., Scudder Mt., *Q. A. Blackburn, R. S. Russell Jr. & S. D. L. Paine QM-2.*

Thallus assimilans 1–2 mm. diametro, rarus, delicatus, crustosus arachnoideusve, dilute flavus, inconspicuus; cortex non evolutus vel paucis cellulis isodiametricis aut cellulis fastigiatis sub apothecio; algae ad 12 μ diametro, protococcoideae, coloniis parvis sparsis, densioribus sub apothecio; medulla ad 350 μ crassitudine, hyphis 1–1.5 μ diametro; cortex inferior deest.

Apothecia ad 1.5 mm. diametro, subspherica, sparsa aut gregaria, dilute flavovirentia aut obscure virentia nigricantiave; amphithecium deest; parathecium 60–85 μ subtus, hyphis tenuibus gelifactis flabellatim dispositis; hypothecium 10–20 μ, hyphis tenuibus dense compactum, hyalinum; thecium ad 35 μ altitudine; paraphyses 1 μ diametro, capitibus ad 2 μ, septati, vaginati, KOH virescentes, epithecium circa 5 μ crassitudine; asci 30–32 × 11–12 μ, breves, late clavati, vaginati; ascosporae octonae, 9–10 × 2.5–3 μ, ellipsoideae reniformesve, apicibus obtusis, hyalinae.

Assimilative thallus 1–2 mm., extremely scant, delicate, crustose to arachnoid, yellowish white, limited to the bases of apothecia and often penetrating cracks or small fissures in the rocks, very inconspicuous; cortex not developed except for a few isodiametric cells and a small region of fastigiate cells next the apothecium; algae up to 12 μ in diameter, protococcoid, scant, scattered through the thallus in small groups, slightly more massed beneath the apothecium; medulla up to 350 μ thick, of slender hyphae 1–1.5 μ in diameter, more closely woven about the algae; lower cortex lacking.

Apothecia up to 1.5 mm. in diameter, subspherical, scattered or more frequently closely gregarious, light yellow-green to dark green and black; no amphithecium; parathecium 60–85 μ thick below, of slender gelified septate hyphae spreading flabellately to 140 μ at the margin; hypothecium 10–20 μ thick, of densely woven hyphae continuous with the parathecium, penetrating the medulla between the colonies of algae, hyaline; thecium about 35 μ tall; paraphyses 1 μ in diameter, heads up to 2 μ, septate, with a thin sheath, greenish with KOH, epithecium about 5 μ thick; asci 30–32 × 11–12 μ, short, broadly clavate with

a prominent sheath, 8-spored; ascospores 9–10 × 2.5–3 μ, ellipsoidal to reniform, the ends blunt, hyaline.

On fine-grained gray granite and granitic sandy loam.

The extremes of color of the apothecia might be considered as corresponding to distinct species but many transitions are evident. In the light-colored apothecia, the ends of the paraphyses are not darkened and the epithecium is hyaline; in the dark-colored or black apothecia the ends of the paraphyses are dark and the epithecium is dark green to black.

S. Victoria Land: Queen Maud Mts., Durham Point, northeast portal of Thorne Glacier, *Q. A. Blackburn, R. S. Russell Jr. & S. D. L. Paine QM-3, QM-4;* Scudder Mt., 86° 03′ S., 150° 40′ W., *Q. A. Blackburn, R. S. Russell Jr. & S. D. L. Paine QM-2,* type, *QM-6(1), QM-6(4).*

BLASTENIA

Blastenia Massalongo, Atti I. R. Ist. Venet. II. **3**: append. 101. 1852; Flora **35**: 575. 1852.

The type species of *Blastenia* was not designated. Of the six species treated, four are now placed in *Caloplaca,* so the choice is narrowed to *B. sinapisperma* (Lamarck) Mass. and *B. Visianica* Mass. Since the latter species may be considered as the type of *Kuttlingeria,* we choose *B. sinapisperma* (Lamarck) Mass.

Thallus crustose, uniform, continuous, powdery, granulose or rimrose, attached to the substrate by the hyphae of the prothallus or of the medulla, homoeomerous or heteromerous; ecorticate; algae *Protococcus.* Apothecia round, immersed or sessile, light or dark; parathecium well developed, very rarely including a few algal cells; epithecium granular or powdery, becoming violet or purple with KOH; hypothecium hyaline; paraphyses simple, septate, capitate; asci 4–16-spored; ascospores hyaline, ellipsoid to elongate, polaribilocular. Spermogonia immersed, spherical, spermatia short, cylindric, straight, rarely acicular or curved.

KEY TO ANTARCTIC SPECIES

Thallus continuous, amber yellow; ascospores 13–16 × 6.5–8(–9) μ...... *B. succinea*

Thallus granulose to verrucose.

Thallus white; apothecia convex, margin evanescent; ascospores 12–22 × 6–11 μ...... *B. leucoraea*

Thallus deep olive buff, gray, or black; apothecia concave, margin persistent; ascospores 11–15 × 6–8 μ .... *B. grisea*

BLASTENIA **succinea** Dodge & Baker, sp. nov.
Pl. 53, figs. 250–254.

Type: Marie Byrd Land, Edsel Ford Range, Lichen Peak, *P. Siple & S. Corey 73-7.*

Thallus crustosus, mollis vel subgelifactus madefactus, irregularis, continuus, albidus vel succineo-flavus, vel marginibus subbrunneis; cortex 10–20 μ crassitudine, fastigiatus, non continuus, paucis cellulis exteris obscurioribus; algae protococcoideae, solo in strato coloniarum sparsarum sub hypothecio visae; medulla 100–200 μ crassitudine, hyphis tenuibus reticulatim dispositis; stratum basale non evolutum sed totus thallus super speciem *Rivulariae* innascens et ejus hyphae partem superiorem vaginae penetrantes.

Apothecia ad 1 mm. saepe circa 0.5 mm. diametro, irregularia, concava juventute, applanata vel repanda maturitate, brunnea vel nigra, purpureo-rubescens KOH addito; amphithecium non evolutum sed stratum gonidiale sub hypothecio adest; parathecium paucis cellulis in cortice mergens; hypothecium 10–20 μ crassitudine, hyalinum, hyphis tenuibus compactis; thecium 40–60 μ altitudine; paraphyses 1–1.5 μ diametro, apicibus vaginatis, ad 6 μ diametro, obscurascentibus, ad apices ramosi vel non ramosi, septati, vaginati, epithecium 5–10 μ crassitudine, obscurum sed non carbonaceum, densum, gelifactum; asci 40–48 × 17–22 μ, elongato-clavati juventute, late clavati maturitate; ascosporae octonae, 13–16 × 6.5–8(–9) μ, polaribiloculares cellulis separatis, quaque uninucleata, hyalinae, ellipsoideae, apicibus obtusis vel subacutis.

Thallus a few mm. in diameter at its best development, crustose, soft to somewhat gelified when moist, irregular, continuous, not conspicuously areolate, whitish to amber yellow, sometimes brownish at the margins; upper cortex 10–20 μ, not continuous, fastigiate, a few outer cells somewhat darkened; algae *Protococcus* seen only in a layer of scattered colonies beneath the hypothecium; medulla 100–200 μ thick, of slender reticulate hyphae, basal layer not differentiated, the whole usually growing over a gelified mass of *Rivularia* sp. with a few medullar hyphae penetrating the upper portions of the gel but apparently not being stimulated by the alga to form cephalodia.

Apothecia up to 1 mm. in diameter, usually smaller, about 0.5 mm., irregular, circular, concave when young becoming flattened or even convex at maturity, without an amphithecium, brown to black, turning purple-red with KOH; parathecium of a few cells merging with the cortex; hypothecium 10–20 μ, not

thinning toward the margin, of slender, compactly reticulate hyphae; thecium 40–60 μ high; paraphyses 1–1.5 μ, expanding slightly to enlarged apices which are surrounded by a gel which reaches a diameter of 6 μ, usually darkened on the outer surfaces, branched near the tip or unbranched, septate, sheathed, epithecium 5–10 μ thick, dark but not carbonaceous, gelified, dense; asci 40–48 × 17–22 μ, 8-spored, elongate-clavate when young but short and broadly clavate at maturity; ascospores 13–16 × 6.5–8(–9) μ, polaribilocular, the cells distinctly separated, each uninucleate, hyaline, ellipsoidal, the ends blunt to somewhat pointed.

Growing over mosses, *Umbilicaria cerebriformis*, sandy loam from granite, and dark greenish gray slate.

The thallus seems much reduced in this species. Apparently an areole functions as an assimilative unit for a certain time, then the biatorine apothecium develops just above the algal layer, covering the whole areole. Perhaps it is approaching heterotrophism by securing much of its nourishment from the *Rivularia* species with a corresponding reduction of thallus as is often found with increasing parasitism.

MARIE BYRD LAND: Edsel Ford Range, Mt. Rea-Cooper, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff R-2;* Skua Gull Peak, *P. Siple & S. Corey 72W-5, 72W-14;* Lichen Peak, *P. Siple & S. Corey 73-4, 73-7,* type.

BLASTENIA **grisea** Dodge & Baker, sp. nov.

Pl. 53, figs. 255–260.

Type: Marie Byrd Land, Edsel Ford Range, Lichen Peak, *P. Siple & S. Corey 73-6.*

Thallus non assimilans ad 1 mm. longitudine, funiculis nigris, fimbriatis; thallus assimilans 20 × 8 mm., granulosus, lobatus, subfruticosus, delicatus, pallide flavus, olivaceo-alutaceus, griseus nigricansve; cortex male evolutus, cellulis fuscis isodiametricis in lateribus areolarum sparsis, fastigiatis; algae ad 10 μ, protococcoideae, sparsae, paucae; medulla 150–200 μ crassitudine, cellularis (sensu Nylander) ad apothecium, hyphis reticulatim dispositis; cortex inferior nullus.

Apothecia ad 0.65 mm. diametro, circularia, concava, marginata, raro subimmersa, aurantio-brunnea, rubro-brunnea vel nigra, KOH rubescens; amphithecium deest; parathecium 10–20 μ crassitudine, paucis cellulis eis epitheciorum similibus; hypothecium 30–40 μ crassitudine, hyalinum, hyphis tenuibus; thecium 40–50 μ altitudine; paraphyses 0.5–1.0 μ, apicibus 1.5 μ diametro, subflexuosi, septati, raro ramosi, epithecium 10–20 μ, hyalinum; asci 34–45 × 10–15 μ, breves, clavati, obtusi;

ascosporae octonae, 11–15 × 6–8 μ, polaribiloculares deinde uniseptatae, hyalinae, cellulis uninucleatis.

Non-assimilative thallus of black fimbriate strands up to 1 mm. long; assimilative portion 20 × 8 mm., granular to lobed, and almost dwarf-fruticose, very delicate, yellowish white to deep olive buff or gray and black; cortex not well developed except for a few lateral regions where scattered fuscous isodiametric cells are found with fastigiate dark cells over the algal layer; algae up to 10 μ, protococcoid, scattered in the thallus or occasionally near the surface, scant; medulla 150–200 μ thick, cellular (*sensu* Nylander) near the apothecium, but mostly of reticulately woven hyphae; lower cortex not differentiated.

Apothecia up to 0.65 mm. in diameter, small, more or less circular, concave with a small margin, sometimes almost immersed in the thallus, dull orange to red-brown and black, red with KOH; parathecium 10–20 μ thick, of a few cells scarcely differing from those of the adjacent epithecium; hypothecium 30–40 μ thick, hyaline, tapering slightly from the center, filamentous; thecium 40–50 μ tall; paraphyses 0.5–1.0 μ in diameter reaching 1.5 μ at the tips, somewhat flexuous, septate, occasionally branched, scarcely expanded above and not darkened, epithecium 10–20 μ, light; asci 34–45 × 10–15 μ, short-clavate, blunt at both ends at maturity, 8-spored; ascospores 11–15 × 6–8 μ, polaribilocular at first, becoming septate, hyaline, each cell uninucleate.

On arkosic sandstone.

Marie Byrd Land: Edsel Ford Range, Lichen Peak, *P. Siple & S. Corey 73-4, 73-6*, type.

KUTTLINGERIA

Kuttlingeria Trevisan, Riv. Period. Lav. Accad. Padova **5**: 72. 1857.

The type species is *K. Visianii* Trevisan (*Blastenia Visianica* Mass.). The other species originally included by Trevisan agree less well with the generic description and are considered as belonging in *Blastenia* Mass., from which this genus was segregated.

Thallus crustose, central portion granulose, areolate, margin effigurate, lobate to subfoliose, corticate; algae protococcoid;

medulla filamentous, basal cortex present. Apothecia biatorine, adnate; parathecium well developed; hypothecium hyaline; paraphyses branched or simple, capitate; asci clavate, 8-spored; ascospores polaribilocular at first, becoming uniseptate.

KUTTLINGERIA **rufa** Dodge & Baker, sp. nov.

Pl. 53, figs. 261–266; pl. 65, fig. 425.

Type: Marie Byrd Land, Edsel Ford Range, Mt. Donald Woodward, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff DW-4.*

Thallus in area 1.5 cm. diametro radians, lobulis ad 1.1 mm. latitudine, irregulariter ramosis, marginibus impendentibus vel applanatis, in saxis appressus, rufus Martis vel salmoneo-aurantius albusve, KOH addito obscure rubescens; cortex 20–30 μ crassitudine, centro saepe abest, pseudoparenchymaticus, cellulis leptodermaticis; stratum gonidiale 55–60 μ crassitudine, coloniis paucis parvisque late dispositis; medulla ad 500 μ crassitudine, hyphis 3.5–4 μ diametro, laxe reticulatimque dispositis anastomosantibusque, in areis decorticatis compactioribus; cortex inferior similis cortici superiori.

Apothecia ad 0.3 mm. diametro, sparsa, sessilia, concoloria, convexa; amphithecium deest; parathecium male evolutum, paucis cellulis in cortice marginali mergens, cortex marginalis ad 15 μ crassitudine; hypothecium 30–40 μ, hyalinum, hyphis tenuibus compacte reticulatis; thecium 50–60 μ altitudine; paraphyses 1 μ diametro, apicibus 2–2.5 μ, cellula penultima maiore quam cellula ultima, ad 3.5 μ diametro, raro ad apicem ramosi, non vaginati, insuper septati, basaliter cellulis longioribus vel non septati, epithecium gelifactum, 5–10 μ crassitudine, brunneum; asci 44–55 × 11–14 μ, elongato-clavati juventute, latiores maturitate, apicibus vaginatis; ascosporae 12–15 × 5–7 μ, octonae, polaribiloculares, quaque cellula uninucleata, tenuiter ellipsoideae, apicibus subacutis.

Thallus radiate over an area 1.5 cm. in diameter, of irregularly branched lobes up to 1.1 mm. across, the margins overhanging, flattened, closely attached to the substratum, Mars red to salmon orange, white over decorticate portions in the center of the thallus, dark red with KOH; upper cortex 20–30 μ thick where best developed, pseudoparenchymatous, an even layer of thin-walled cells; algal layer 55–60 μ thick, of a few small colonies scattered through the layer; medulla up to 500 μ thick, of rather coarse hyphae 3.5–4 μ in diameter loosely reticulate and anastomosed, in the decorticate areas extending to the surface where it is thicker and more closely reticulate but never stratified, slightly more compact in areas adjacent to the cortex; lower cortex similar to the upper cortex.

Apothecia up to 0.3 mm. in diameter, scattered, sessile, usually well back from the extremities of the lobes, concolorous with the thallus, convex, strongly so when young, but without an amphithecium; parathecium thinning above, an upward continuation of the hypothecium merging with the cortex which reaches about 15 μ thick; hypothecium 30–40 μ thick, hyaline, of slender closely reticulated hyphae; thecium 50–60 μ tall; paraphyses 2–2.5 μ at the tip, tapering to 1 μ in diameter below, the penultimate cell often exceeding the apical cell, up to 3.5 μ in diameter, occasionally branched near the tips, without sheaths, septate above, of longer cells or undivided below, epithecium 5–10 μ, gelified, golden brown to darker brown; asci 44–55 × 11–14 μ, 8-spored, elongate-clavate when young, broadly so at maturity, sheath apically prominent; ascospores 12–15 × 5–7 μ, polaribilocular, each cell uninucleate, slender-ellipsoidal with somewhat pointed ends.

On biotite sericite.

MARIE BYRD LAND: Edsel Ford Range, Mt. Donald Woodward, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff DW-4*, type.

KUTTLINGERIA **rutilans** Dodge & Baker, sp. nov.

Pl. 53, fig. 267; pl. 54, figs. 268–270.

Type: Marie Byrd Land, Edsel Ford Range, Skua Gull Peak, *P. Siple & S. Corey 72W-9.*

Thallus ad 15 mm. diametro, foliosus vel subfruticosus, lobatus, lobis elongatis, angustis, contortis, irregulariter dichotome ramosis, rutilans; cortex 8–12 μ crassitudine, cellulis isodiametricis; algae protococcoideae, ad 10 μ diametro, sub cortice sparsae, paucae, sub apothecio gregariae; medulla laxissime contexta, hyphis tenuibus; cortex inferior bene evolutus, cum superiore congruens.

Apothecia ad 0.5 mm. diametro, sine margine conspicua, rufus; amphithecium deest; parathecium 40–50 μ crassitudine, hyalinum, hyphis septatis, 3–4 μ, dense implexis, sub hypothecio continuum; hypothecium 10–12 μ crassitudine, hyalinum, hyphis irregulariter implexis; thecium 50–65 μ altitudine; paraphyses 0.5 μ diametro, capitibus majoribus, vaginatis, ad 3.5 μ diametro, simplices vel ramosi, septati, hyalini, epithecium 5–10 μ crassitudine, flavum, crystallis numerosissimis; asci 55–64 × 14.5–15 μ, elongati, clavati, obtusi, vaginati; ascosporae octonae, 12.5–13.5 × 7–8 μ, polaribiloculares, uninucleatae, hyalinae.

Non-assimilative portion lacking; assimilative thallus up to 15 mm. in diameter, foliose to subfruticose, lobes long, narrow, contorted, irregularly dichotomously branched, grena-

dine red to English red; cortex 8–12 μ thick, a dense layer of isodiametric cells, only the outermost darkened; algae protococcoid, up to 10 μ in diameter, scattered near the upper cortex, few, more closely packed below the apothecium; medulla very loosely woven, of slender hyphae; lower cortex identical with the upper.

Apothecia up to 0.5 mm. in diameter, flattened, without a conspicuous margin, grenadine red to English red; amphithecium absent; parathecium 40–50 μ thick, hyaline, of closely woven septate hyphae 3–4 μ in diameter continued below the hypothecium which is 10–12 μ thick, hyaline, of closely and irregularly woven cells, not tapering outward; thecium 50–65 μ tall; paraphyses 0.5 μ in diameter, gradually expanding to larger cells near the tips, heads with conspicuous sheaths up to 3.5 μ in diameter, branched or simple, hyaline throughout, epithecium 5–10 μ thick, yellow, composed of numerous crystals; asci 55–64 × 14.5–15 μ, elongate, clavate, rather blunt, with a conspicuous sheath, 8-spored; ascospores 12.5–13.5 × 7–8 μ, polaribilocular, cells uninucleate, hyaline.

Loose on moss clumps and sandy loam.

MARIE BYRD LAND: Edsel Ford Range, Skua Gull Peak, *P. Siple & S. Corey 72W-9*, type.

HUEA

Huea Dodge & Baker, gen. nov.

The type species is *Huea flava* Dodge & Baker.

Thallus crustosus, rugosus, granulosusve, ecorticatus corticatusve; algae protococcoideae; cortex inferior non evolutus. Apothecia sessilia, circularia, nigra; parathecium nigrum, carbonaceum, pseudoparenchymaticum, sub hypothecio continuum; hypothecium fuscum, hyphis tenuibus dense compactum; epithecium nigrum; ascosporae octonae, ellipsoideae, hyalinae, polaribiloculares. Spermogonia immersa, ostiolis nigris, spermatiophorae ramosae, articulatae; spermatia cylindrica, brevia, recta.

Thallus crustose, uniform, rugose, granulose, attached to the substrate by the medullar hyphae, heteromerous, ecorticate or corticate; algae protococcoid; basal cortex not differentiated. Apothecia sessile, circular, black; parathecium black, carbonaceous, pseudoparenchymatous, continued in a thick layer below the hypothecium which is dark; epithecium

black, asci 8-spored; ascospores ellipsoid, hyaline, polaribilocular. Spermogonia immersed, with a black ostiole, spermatiophores branched and closely septate; spermatia cylindric, short, straight.

So far as known, this genus is confined to the Antarctic. **Huea cerussata** (Hue) Dodge & Baker, comb. nov. *(Lecidea (Blastenia) cerussata* Hue, Deuxième Exp. Antarct. Franç. Lichens, 101. 1915) and **Huea coralligera** (Hue) Dodge & Baker, comb. nov. *(Lecidea (Blastenia) coralligera* Hue, Deuxième Exp. Antarct. Franç. Lichens, 102. 1915) have been described from the Graham Land Archipelago. Hue first pointed out these species as differing from all other species in his section *Blastenia* in the structure of the parathecium; hence it gives us pleasure to dedicate this genus to him.

KEY TO ANTARCTIC SPECIES

Thallus ecorticate, yellow, granulose.................................*H. flava*
Thallus corticate.
  Thallus whitish, surface rugose to granulose, verrucose; cortex 10–40 μ, without layer of dead cells.................................*H. cerussata*
  Thallus ashy to black, surface coralloid; cortex 20 μ, with layer of dead cells.................................*H. coralligera*

HUEA **flava** Dodge & Baker, sp. nov.

Pl. 54, figs. 271–275.

Type: Marie Byrd Land, Edsel Ford Range, Lichen Peak, *P. Siple & S. Corey 73-10.*

Thallus assimilans ad 1.5 mm., granulosus, mollis madefactus, flavus; ecorticatus; algae ad 18 μ diametro, protococcoideae, per thallum sparsae, paucae; medulla circa 200 μ diametro, hyphis 2–3 μ diametro, pachydermaticis, reticulatim dispositis, densioribus ad algas et in basi; cortex inferior deest.

Apothecia ad 0.25 mm. diametro, irregulariter circularia, marginata, nigra, carbonacea; amphithecium deest; parathecium 20–30 μ crassitudine, cellulis nigris pachydermaticis, carbonaceum, sub hypothecio continuum; hypothecium 10–15 μ crassitudine, brunneum fuscumve, hyphis dense compactis; thecium 30–40 μ altitudine; paraphyses 1–1.5 μ, apicibus vaginatis, ad 4 μ diametro, obscure griseo-viridibus, septati, simplices, raro ramosi, epithecium 5–10 μ, obscurum; asci 27–36 × 10–14 μ, clavati, vaginati; ascosporae octonae, 8–9 × 4–4.5 μ, polaribiloculares, ellipsoideae, hyalinae, cellulis uninucleatis.

Non-assimilative portion of thallus lacking; assimilative thallus up to 1.5 mm. in diameter, scant, granulose, soft when

moistened, yellow; ecorticate; algae up to 18 μ in diameter, protococcoid, few, scattered in the thallus; medulla about 200 μ thick, of thick-walled hyphae 2–3 μ in diameter, loosely reticulate, closer near the algae and near the base; lower cortex lacking.

Apothecia up to 0.25 mm. in diameter, irregularly circular, marginate, black, carbonaceous; amphithecium not developed; parathecium 20–30 μ thick, of thick-walled black cells, so dark their individuality is obscured, continuous under the hypothecium, tapering slightly at the margin; hypothecium 10–15 μ thick, brown to fuscous, of densely interwoven hyphae; thecium about 30–40 μ tall; paraphyses 1–1.5 μ in diameter, apical cells surrounded by large gelified sheaths up to 4 μ in diameter, dark greenish gray, septate, simple or rarely branched; epithecium 5–10 μ, dark; asci 27–36 × 10–14 μ, clavate, with a small sheath, 8-spored; ascospores 8–9 × 4–4.5 μ, polaribilocular, the cells separate, each uninucleate, hyaline, ellipsoidal.

On weathered coarse-grained pinkish gray granite, fine-grained dike, and sericite-orthoclase schist.

MARIE BYRD LAND: Edsel Ford Range, Mt. Rea-Cooper, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff R-7*; Lichen Peak, *P. Siple & S. Corey 73-7, 73-10*, type; Mt. Stancliff, *P. Siple & S. Corey 72A-1.*

PYRENODESMIA

PYRENODESMIA Massalongo, Atti I.R. Ist. Veneto, II. **3**: 119. 1853.

Callopisma DeNotaris, Giorn. Bot. Ital. II. **2**: 198. 1847, non *Callopisma* Martius, Nov. Gen. Sp. Pl. **2**: 107. *pl. 183, 184.* 1827 (Gentianaceae).

Caloplaca Th. Fries, Lich. Arctoi, 218. 1860.

The type of *Pyrenodesmia* is not designated. *P. Agardhiana* (Fw.) Mass., *P. chalybaea* (Fr.) Mass., *P. olivacea* Mass., and *P. variabilis* (Pers.) Mass. were treated, all in *Caloplaca* sect. *Eucaloplaca* as understood by recent authors. The type of *Callopisma* may be chosen as *C. cerina* (Ehrh.) DNtrs., since *C. murorum* (Hoffm.) DNtrs. and *C. vulgaris* DNtrs. were transferred to *Gasparrinia* by Tornabène in 1849 and by DeNotaris to *Aglaopisma* in Baglietto in 1856. The

type of *Caloplaca* was not designated. Seven species were listed, of which *C. cerina* (Ehrh.) Th. Fr. may be taken as the type, since Th. Fries merely intended *Caloplaca* to replace *Callopisma* which had previously been used by Martius.

Thallus crustose, attached to the substrate by the hyphae of the prothallus or of the medulla, without rhizinae, uniform, mostly yellow and becoming purple with KOH, heteromerous; ecorticate or nearly so; algae *Protococcus;* medulla arachnoid, of thin-walled hyphae. Apothecia round, appressed or sessile, seldom immersed, lecanorine with well-developed amphithecium containing cortex, algal layer, and medulla; epithecium granulose to powdery, usually becoming purple or violet with KOH; hypothecium hyaline, lying above the algal layer; paraphyses simple, septate, capitate; asci 8-spored; ascospores hyaline, ellipsoidal to rhomboidal, usually polaribilocular, often the cells appearing connected by an isthmus. Spermogonia immersed, with a hyaline wall, spermatiophores close-septate; spermatia short, straight, elongate to cylindrical.

KEY TO ANTARCTIC SPECIES

Growing over mosses.
  Thallus not developed; ascospores 10–12 × 7–9 μ.................*P. athallina*
  Thallus well developed, ecorticate; sterile.......................*P. Darbishirei*
Saxicolous.
  Cortex of vertical hyphae, upper half fastigiate; thecium 90–100 μ; ascospores 12–16 × 7–8 μ.................................*P. cinericola*
  Cortex of intricate hyphae.
    Cortex 20–30 μ; thecium 80–100 μ; ascospores 12–16 × 5–7 μ......*P. citrina*
    Cortex 30–70 μ; thecium 70–80 μ; ascospores 12–24 × 6–14 μ....*P. aurantiaca*

PYRENODESMIA **Darbishirei** Dodge & Baker, sp. nov. Pl. 62, figs. 401–403; pl. 63, fig. 411.

Physcia cirrhochroa Darbishire, Nat. Antarct. [Discovery] Exp. Nat. Hist. 5: Lichenes, 9. 1910, non Ach.

Type: Marie Byrd Land, Edsel Ford Range, Skua Gull Peak, *P. Siple & S. Corey 72W-14.*

Pars non assimilans inconspicua, male evoluta, funiculis obscuris hypharum, cellulis irregularibus, interne amorpha; pars assimilans ad 2 mm. diametro, 0.50 mm. altitudine, in solo inter muscos, flava vel ochraceo-aurantiaca, inferne albida, KOH rubro-aurantiaca, irregularia, flabellata, marginibus crenulatis; cortex non evolutus, superficie amorpha, 2–8 μ crassitudine; algae protococcoideae, coloniis

subsphericis per totam areolam basi excepto dispositis; medulla cellulis irregularibus leptodermaticis, inferne reticulata, cellulis pachydermaticis subbrunneis; stratum basale non evolutum sed cellulis imis medullaribus pachydermaticis obscurisque.

Non-assimilative portions inconspicuous, not well developed, of dark hyphal strands of irregular cells without definite organization, internally amorphous; assimilative portions up to 2 mm. in diameter and 0.50 mm. high, growing on soil among mosses, often conspicuous over areas of 2–3 cm., primuline yellow to ochraceous orange becoming almost white at the bottom, changing to bright orange-red on the addition of KOH, irregular, flabellate, edges crenulate; upper cortex not differentiated, the outer surface amorphous to a depth of 2–8 μ; algae scattered throughout the areolae except the base, protococcoid, in subspherical colonies; medulla of irregular thin-walled cells near the base, becoming more open and reticulate, the cells with thicker walls, slightly brownish; lower cortex not morphologically differentiated, the lowest row of cells often having the outermost surfaces thickened and dark. Sterile.

Apparently growing over mosses and an old lichen thallus with ellipsoidal colonies of *Nostoc* which has been parasitized by a common brown hyphomycete.

While we have not seen Darbishire's material this seems to be the same imperfect lichen referred by him to *Physcia cirrhochroa* Ach. From the structure of the thallus it seems much more closely related to *Pyrenodesmia*. Darbishire suggested a possible relationship to *Placodium*, i. e. *Gasparrinia*, but its ecorticate condition excludes it from that genus.

Marie Byrd Land: Edsel Ford Range, Skua Gull Peak, *P. Siple & S. Corey 72W-2, 72W-7, 72W-14*, type; Lichen Peak, *P. Siple & S. Corey 73-3, 73-4, 73-7*; Mt. Donald Woodward, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff DW-1*.

Pyrenodesmia **athallina** (Darbishire) Dodge & Baker, comb. nov.

Caloplaca athallina Darbishire, Wiss. Ergebn. Schwed. Südpolar-Exp. 1901-1903. . . Nordenskjöld 4^{11}: 9. *pl. 2. f. 14.* 1912.

Type: Graham Land, Paulet Island, *Skottsberg*.

PYRENODESMIA **aurantiaca** (Lightfoot) Dodge & Baker, comb. nov.

Lichen aurantiacus Lightfoot, Fl. Scotica **2**: 810. 1777.

Caloplaca aurantiaca Th. Fries, Nova Acta R. Soc. Sci. Upsal. III. **3**: 219. 1861.

Type: Scotland, *Lightfoot.*

Reported from the Graham Land Archipelago.

PYRENODESMIA **cinericola** (Hue) Dodge & Baker, comb. nov.

Lecanora (Caloplaca) cinericola Hue, Deuxième Exp. Antarct. Franç. Lich. 72–73. 1915.

Caloplaca cinericola Darbishire, Brit. Antarct. [Terra Nova] Exp. 1910, Bot. **3**: 54. 1923.

Type: Graham Land Archipelago, Deception Island, near Pendulum Cove, *Gain.* This species has a much better developed cortex than is usual in this genus and is referred here on account of its uniform areolate thallus.

GASPARRINIA

GASPARRINIA Tornabène, Lichenogr. Sicula, 27. 1849.

Amphiloma Koerber, Syst. Lich. Germ. 110. 1855, non *Parmelia* sect. *Amphiloma* Fries, Lichenog. Eur. Reform. 87. 1831.

Aglaopisma DeNotaris ap. Baglietto, Mem. Accad. Sci. Torino, II. **17**: 396. 1856.

No type species was designated. Eight species were listed, of which three belong elsewhere. Of the five remaining, two belong in *Pyrenodesmia,* leaving three in the group as subsequently understood. Th. M. Fries retained this group as a subgenus of *Caloplaca* for *C. callopisma* (Ach.) Th. Fr. *(Callopisma vulgaris* DeNotaris), *C. murorum* (Hoffm.) Th. Fr., and added *C. elegans* (Link) Th. Fr. and *C. cirrochroa* (Ach.) Th. Fr. Since Tornabène regarded *C. callopisma* as a variety of *G. murorum* (Hoffm.) Torn., we may choose the latter as the type. Koerber, in proposing *Amphiloma,* discusses *A. elegans* (Link) Koerb. and *A. murorum* (Hoffm.) Koerb. in detail and five other species briefly. If *A. murorum* is taken as the type, the name is an exact synonym of *Gasparrinia;* if *A. elegans* (Link) Koerb. be chosen it must be shown that it

is not congeneric with *Gasparrinia murorum*. *Aglaopisma* was based on *A. murorum* (Hoffm.) DNtrs. and *A. vulgaris* DNtrs. *(Gasparrinia murorum* v. *callopisma* Tornabène). Therefore this also is an exact synonym of *Gasparrinia*.

Thallus crustose, attached to the substrate directly, or by rhizinae, effigurate or lobed and subfoliose at the margin, mostly yellow and becoming purple with KOH, heteromerous; corticate on both surfaces, cortex pseudoparenchymatous, cells thin-walled; algae *Protococcus*; medulla arachnoid, of thin-walled hyphae. Apothecia round, appressed or sessile, lecanorine; amphithecium containing cortex, algae, and medulla; epithecium granulose or powdery, usually becoming purple or violet with KOH; hypothecium hyaline, lying above the algal layer; paraphyses simple, septate, capitate; asci 8-spored; ascospores hyaline, ellipsoidal, polaribilocular, cells often connected by an isthmus. Spermogonia immersed with a hyaline wall, spermatiophores close-septate; spermatia short, straight, cylindric.

KEY TO ANTARCTIC SPECIES

Margin laciniate but more or less indeterminate.
  Apothecia up to 1.5 mm.; laciniae white, ciliate; medullar hyphae vertical; thecium 110–120 μ.. *G. Joannae*
  Apothecia about 0.6 mm.
    Thallus areolate, laciniate; medullar hyphae vertical; thecium 100 μ.... .... *G. sublobulata*
    Thallus reticulate, laciniate; medullar hyphae horizontal; thecium 70–80 μ .... *G. inordinata*
Margin thick.
  Laciniae 0.2–0.3 mm. broad, with sorediose tips; spores 11–18 × 5–6 μ; thecium 80–90 μ.. *G. cirrochrooides*
  Laciniae not sorediose.
    Laciniae torulose, unequal, often shining; spores 11 × 5 μ.......... *G. lucens*
    Laciniae cylindric, center granular; spores 14–18 × 7–9 μ; cortex thick and differentiated into two layers.......................... *G. Gainii*
    Laciniae flattened, center areolate; spores 11–16 × 6–9 μ.......... *G. elegans*
    Laciniae flattened, center subareolate, verrucose; spores 11–16 × 4–7 μ; lower cortex often almost absent.
      Thallus yellow-orange, 0.3–0.5 μ thick, pruinose............. *G. murorum*
      Thallus red-orange and browning, thinner, not pruinose........ v. *miniata*
    Laciniae flattened, center continuous; spores 12.5–16 × 5–8 μ; lower cortex well developed with rhizoidal strands adhering to the rock, cadmium orange to orange-chrome, not pruinose...................... *G. Siplei*

Gasparrinia **Siplei** Dodge & Baker, sp. nov.

Pl. 54, figs. 287–289; pl. 55, figs. 290–296; pl. 65, figs. 429, 431.

Type: Marie Byrd Land, Edsel Ford Range, Skua Gull Peak, *P. Siple & S. Corey 72W-6.*

Thallus ad 20 mm. diametro, subfoliosus, centro continuo, marginibus lobatis, lobis planis, subelevatis, ad 1 mm. latitudine, dichotome vel varie ramosis, apicibus frequenter subdigitatis, lobis minoribus subtorulosis, aurantiacus, KOH addito rufescens; cortex superior 20–40 μ crassitudine, cellulis leptodermaticis isodiametricis, 2–4 μ diametro, laxe contextus, strato 2–5 μ crassitudine, cellularum emortuarum tectus; algae protococcoideae, ad 15 μ diametro, in medulla sparsae et stratum irregulare sub cortice formantes; medulla 180–500 μ crassitudine, hyphis leptodermaticis, 1.5–3 μ diametro, ramosis, irregulariter contexta, densius circum algas; cortex inferior 12–30 μ crassitudine, cellulis isodiametricis leptodermaticis, exteris obscuris; rhizinae cellulis 2–3 μ diametro, fastigiatis, exteris obscuris.

Apothecia ad 1.5 mm. diametro, juventute marginibus inflexis, subconcava vel plana maturitate, aurantiaca, singula vel caespitosa, sessilia; amphithecium 100–150 μ crassitudine, cortice fastigiato, algis multis, sub hypothecio, non in amphithecio penetrantibus, medulla ut in thallo; parathecium 20–30 μ crassitudine, hyalinum, insuper hyphis fastigiatis; hypothecium 30–50 μ crassitudine, hyphis dense compactis, hyalinum ad margines tenuescens; thecium 70–80 μ altitudine; paraphyses 0.75–1.0 μ subtus, cellulis longis, insuper incrassati, cellulis brevibus capitibus ad 3.5 μ diametro, subsphericis, crustati, KOH addito subvirescens, epithecium 10–12 μ crassitudine; asci 60–75 × 11.5–17 μ, elongati et late clavati; ascosporae octonae, 12.5–16 × 5–8 μ, biloculares, cellulis uninucleatis, ellipsoideae, apicibus obtusis vel acutis, hyalinae.

Thallus up to 20 mm. in diameter, subfoliose, center continuous, margin lobed and somewhat elevated; lobes flattened or subcanaliculate, up to 1 mm. wide, dichotomously or variously branched, tips often somewhat digitate, the smaller lobes sometimes little branched and somewhat torulose, cadmium orange to orange chrome, turning bright red with KOH; upper cortex 20–40 μ thick, of thin-walled isodiametric cells 2–4 μ in diameter, somewhat loosely packed, covered by an outer layer 2–5 μ thick of dead cells; algae protococcoid, up to 15 μ in diameter, abundant, scattered in the medulla and forming an irregular layer beneath the cortex; medulla 180–500 μ thick, of thin-walled hyphae 1.5–3 μ in diameter, branching and anastomosing to form an open network, sometimes more closely packed about the algae; lower cortex 12–30 μ thick, of thin-walled, isodiametric cells 2–4 μ in diameter, outer cells darkened, without dead cells; rhizinae common, cells 2–

3 μ in diameter, densely packed in a palisade, darkened on the outer surfaces.

Apothecia up to 1.5 mm. in diameter, margins strongly inrolled when young, only slightly concave or plane at maturity, cadmium orange to orange chrome, single or densely crowded in the center of the thallus, sessile; amphithecium 100–150 μ thick, cortex fastigiate with a gradual transition below to that of the thallus; algae abundant, in a dense layer 40–70 μ thick below the hypothecium, not penetrating the amphithecium, medulla similar to that of the thallus; parathecium 20–30 μ thick, hyaline, fastigiate above; hypothecium 30–50 μ thick, of densely woven hyphae similar to those of the medulla, hyaline, tapering gradually outward; thecium 70–80 μ tall; paraphyses 0.75–1.0 μ in diameter below, cells very long, septa rare, tapering gradually toward the tips with more frequent septa, heads of 3–5 shorter cells, up to 3.5 μ in diameter, the ultimate cells subspherical, covered by a thick rough incrustation, slightly greenish with KOH, branched or simple with a thin sheath above which disappears below, epithecium 10–12 μ thick; asci 8-spored, 60–75 × 11.5–17 μ, elongate and broadly clavate; ascospores 12.5–16 × 5–8 μ, 2-celled, each cell separate with its own nucleus, ellipsoidal with blunt or pointed ends, hyaline.

On erratic fine-grained pink granite, biotite-sericite, orthoclase-sericite-siderite schist, sericite schist, and fine-grained dike.

The systematic position of this species is not clear. The algae do not penetrate the amphithecium as is usual in lecanorine apothecia. On the other hand, there seems to be a differentiation of tissues corresponding to amphithecium and parathecium, the amphithecium being of thalline derivation while the parathecium is connected with the hypothecium. Since no algae occur above the hypothecium in the margin, some might refer the species to *Kuttlingeria.* It is possible, however, that it should be referred to **Xanthoria antarctica** (Vainio) Dodge & Baker, comb. nov. [*Xanthoria lychnea* f. *antarctica* Vainio, Exp. Antarct. Belge Res. Voy. S.Y. Belgica, Bot. Lichens, 22. 1903] on account of the thick continuous center of the thallus and its rhizinae. The latter species has lacerate and granulate

lobes and is sterile, while *G. Siplei* has smooth lobes and is abundantly fruiting. Immature spermogonia on our plant would also suggest reference to *Xanthoria* since they apparently occur in groups of 3–5 immersed in thalline warts at the tips of the lobes rather than singly immersed in the thallus as in *Gasparrinia*. The wall is thin, hyaline, very deeply staining, and the contents are not completely differentiated.

Marie Byrd Land: Edsel Ford Range, Skua Gull Peak, *P. Siple & S. Corey 72W-6*, type, *72W-7*, *72W-14*; Mt. Stancliff, *P. Siple & S. Corey 72A-1*; Mt. Donald Woodward, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff DW-2*.

Gasparrinia **cirrochrooides** (Vainio) Dodge & Baker, comb. nov.

Placodium cirrochrooides Vainio, Res. Voy. S.Y. Belgica, 1897–1899, Bot. Lich. 24. 1903.

Caloplaca (Gasparrinia) cirrochrooides Zahlbr., Cat. Lich. Univ. **7**: 225. 1931.

Type: Graham Land Archipelago, Danco Land, Cape Anna Osterrieth, 64° 33′ S., *E. G. Racovitsa*.

Gasparrinia **inordinata** (Hue) Dodge & Baker, comb. nov.

Lecanora (Placodium) inordinata Hue, Deuxième Exp. Antarct. Franç. Lich. 70. 1915.

Placodium inordinata Darbishire, Brit. Antarct. [Terra Nova] Exp. 1910. Bot. 53. 1923.

Caloplaca (Gasparrinia) inordinata Zahlbr., Cat. Lich. Univ. **7**: 241. 1931.

Type: South Shetlands, Deception Island, *Gain 73*.

Gasparrinia **Joannae** (Hue) Dodge & Baker, comb. nov.

Lecanora (Placodium) Joannae Hue, Deuxième Exp. Antarct. Franç. Lich. 68. 1915.

Placodium Joannae Darbishire, Brit. Antarct. [Terra Nova] Exp. 1910. Bot. 53. 1923.

Caloplaca (Gasparrinia) Joannae Zahlbr., Cat. Lich. Univ. **7**: 241. 1931.

Type: Graham Land, Booth-Wandel Island, *Gain 119*.

Gasparrinia **lucens** (Nylander) Dodge & Baker, comb. nov.

Lecanora elegans f. *lucens* Nylander ap. Crombie, Jour. Linn. Soc. Bot. **15**: 184. 1876.

Placodium lucens Nylander, Lich. Nov. Zelandiae, 145. 1888.

Caloplaca (Gasparrinia) lucens Zahlbr., Deutsch. Südpolar Exp. 1901–1903, **8**: 29. 1906.

Type: Kerguelen Land, Observatory Bay, *A. E. Eaton.*

Gasparrinia **sublobulata** (Nylander) Dodge & Baker, comb. nov.

Placodium sublobulatum Nylander, Lich. Fueg. Patagon. 7. 1887.

Lecanora (Placodium) sublobulata Hue, Deuxième Exp. Antarct. Franç. Lich. 69. 1915.

Caloplaca (Gasparrinia) sublobulata Zahlbr., Cat. Lich. Univ. **7**: 267. 1931.

Type: Staten Island, *C. Spegazzini.*

POLYCAULIONA

Polycauliona Hue, Exp. Antarct. Franç. (1903–1905) Sci. Nat. Lich. 8. 1908.

Placodium sect. *Thamnoma* Tuckerman, Gen. Lich. 107. 1872.

The type species is *Polycauliona regalis* (Vainio) Hue. The type of *Placodium* sect. *Thamnoma* is *Placodium coralloides* Tuckerman.

Thallus fruticulose, yellow to chestnut, structure radiate, erect or decumbent at the periphery, dichotomous or irregularly branched, branches often short and nodulose; cortex completely surrounding the thallus, duplex, the outer zone amorphous, from hyphae perpendicular to the axis, the inner more branched and much more slender; algae *Protococcus,* medulla of hyphae parallel to the axis, closely conglutinate. Apothecia terminal on the main axis or branches, constricted at the base, concave then flattened, disc orange; amphithecium and parathecium well developed; hypothecium hyaline; paraphyses hyaline, yellow, or rufous above; asci cylindric or somewhat ventricose in the middle, base caudate, 8-spored; spores hyaline, unicellular or polaribilocular. Spermogonia terminal on the axis and branches, round, spermatia cylindric, straight, septate.

Our species differ from those previously referred to *Polycauliona* in having the central portion of the medulla so loosely woven as to appear almost hollow, much as the section *Eumitria* differs from the other sections of *Usnea.*

KEY TO ANTARCTIC SPECIES

Spores unicellular; thallus brown .... *P. Charcoti*
Spores polaribilocular.
  Thallus greenish .... *P. luctuosa*
  Thallus yellow.
    Thallus erect, up to 30 mm. high .... *P. regalis*
    Thallus prostrate, 3 mm. high.
      Lobes terete .... *P. regalis* f. *prostrata*
      Lobes flattened, subcanaliculate .... *P. coralligera*
  Thallus scarlet to deep orange above.
    Thallus in large pulvinate tufts .... *P. pulvinata*
    Thallus small, scattered, often growing over other lichens and mosses.....
      .... *P. sparsa*

Polycauliona pulvinata Dodge & Baker, sp. nov.
Pl. 54, figs. 276–280; pl. 65, fig. 430.

Type: Marie Byrd Land, Edsel Ford Range, Mt. Rea-Cooper, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff R-3.*

Thallus suffruticosus, dense pulvinatus, ad 25 mm. diametro, 7–8 mm. altitudine, lobis torulosis applanatisve, intricate ramosis, aurantiacus cadmii aut capucino-flavus, subtus dilute flavo-aurantiacus; cortex 30–50 μ crassitudine, cellulis 2–5 μ diametro, isodiametricis, cum strato cellularum emortuarum ad 5 μ crassitudine; algae ad 12 μ diametro, protococcoideae, singulae aut in coloniis parvis per totum thallum sparsae; medulla ad 250 μ crassitudine, funiculis hypharum leptodermaticarum circa 2 μ diametro, laxe intertextis; cortex inferior 30–65 μ crassitudine, cortici superiori similis.

Apothecia ad 1 mm. diametro, marginata, concava, aurantiaca Martis aut rufa Anglorum; amphithecium 90–100 μ crassitudine; cortex ei thalli similis; algae coloniis parvis sparsae; parathecium non evolutum; hypothecium 20–30 μ crassitudine, hyalinum, hyphis dense compactum, non tenuescens; thecium 60–70 μ altitudine; paraphyses 1 μ diametro, capitibus 3.5–4.0 μ, obovoideis vel subsphericis, ad apicem repetito ramosi; asci 52–56 × 18–21 μ, clavati, vaginati; ascosporae octonae, 11–14 × 6–7 μ, ellipsoideae, uniseptatae, hyalinae.

Thallus dwarf-fruticose, in dense pulvinate tufts up to 25 mm. in diameter, 7–8 mm. tall, lobes torulose or flattened and intricately branched so that it is impossible to trace the older branches, cadmium orange to capucine yellow, below paler, capucine buff to pale yellow-orange; cortex 30–50 μ thick, of isodiametric cells 2–5 μ in diameter, covered by a layer of dead

cells up to 5 μ thick; algae up to 12 μ, protococcoid, scant, single or in small colonies scattered throughout the thallus; medulla up to 250 μ thick, of strands of thin-walled branched hyphae 2 μ in diameter, loosely interwoven and almost lacking in the center; lower cortex 30–65 μ thick, continuous and identical with the upper cortex. Occasionally foreign algae occur in great patches on the under side, but since they seem to be devoid of hyphae they can scarcely be regarded as true cephalodia.

Apothecia up to 1 mm. in diameter, marginate, concave especially when young, Mars orange to English red; amphithecium 90–100 μ thick, cortex identical and continuous with that of the thallus; algae scattered throughout in small colonies; medulla similar to that of the thallus; parathecium not differentiated; hypothecium 20–30 μ thick, hyaline, denser than the medulla, not tapering much; thecium 60–70 μ tall; paraphyses 1 μ in diameter, tips 3.5–4 μ, more or less racquet-shaped or sometimes almost subspherical, often repeatedly branched near the tips, not darkened; asci 8-spored, 52–56 × 18–21 μ, slender-clavate with a moderate sheath; ascospores 11–14 × 6–7 μ, ellipsoidal, 2-celled, each cell distinct with its own nucleus, hyaline.

On biotite-sericite schist, fine-grained dike, and highly metamorphosed sedimentary rocks.

Marie Byrd Land: Edsel Ford Range, Mt. Rea-Cooper, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff R-3*, type; Mt. Donald Woodward, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff DW-2;* Mt. Stancliff, *P. Siple & S. Corey 72A-1;* Skua Gull Peak, *P. Siple & S. Corey 72W-6, 72W-7, 72W-14.*

Polycauliona **sparsa** Dodge & Baker, sp. nov.

Pl. 54, figs. 281–286.

Type: Marie Byrd Land, Skua Gull Peak, *P. Siple & S. Corey 72W-5.*

Thallus suffruticosus aut herpetiformis super lichenibus muscisque, lobis gracilibus, paullo ramosis, torulosis vel subapplanatis, raro ad 0.5 mm. diametro, coccineus, subtus salmoneo-aurantiacus; cortex 10–15 μ crassitudine, cellulis isodiametricis, exteris obscuris; algae ad 15 μ diametro protococcoideae, sub cortice sparsae aut in strato 20–30 μ crassitudine sub hypothecio; medulla 200–300 μ crassitudine, funiculis hypharum 2–4 μ diametro, ramosarum reticulatim, densius

sub apothecio corticeque laxissime loborum centro dispositis; cortex inferior superiori similis.

Apothecia ad 1 mm. diametro, plana convexave, marginata, juventute inflexa, coccinea, sessilia, singula; amphithecium 60–80 μ crassitudine, thallo simile; parathecium circa 20 μ crassitudine, hyphis tenuibus flavis dense compactum; thecium 40–50 μ altitudine; paraphyses 1 μ diametro, moniliformes, ramosi, cellulis brevibus, ovoideis, penultima quam ultima majore, ad 3 μ diametro, epithecium hyalinum, KOH addito coccineum; asci 42–48 × (10–)14–16 μ, obtuse clavati; ascosporae octonae, 12–15 × 6–8 μ, polaribiloculares, cellulis separatis, uninucleatis, ellipsoideae, hyalinae.

Thallus dwarf-fruticose or growing over other lichens and mosses, lobes slender, sparingly branched, torulose or somewhat flattened, rarely reaching 0.5 mm. in width, scarlet, below salmon orange; cortex 10–15 μ thick, of isodiametric cells, the outermost darkened; algae up to 15 μ in diameter, protococcoid, scattered in the thallus below the upper cortex and massed in a layer 20–30 μ thick below the hypothecium; medulla about 200–300 μ thick, of strands of hyphae 2–4 μ in diameter, frequently branched in a loose net, denser below the apothecium; lower cortex identical with the upper cortex.

Apothecia up to 1 mm. in diameter, flattened to convex with a small margin, inrolled when young, scarlet, sessile on the lobes, single and scattered; amphithecium 60–80 μ thick, cortex and medulla continuous with those of the thallus and of the same structure; algae scattered in the medulla; parathecium about 20 μ thick, of hyaline hyphae with fastigiately branched tips; hypothecium 10 μ, yellowish, of compact hyphae; thecium 40–50 μ tall; paraphyses 1 μ in diameter, branched, almost moniliform, cells ovoid, the penultimate usually larger than the ultimate which are up to 3 μ in diameter, epithecium hyaline becoming bright red with KOH; asci 42–48 × (10–)14–16 μ, bluntly clavate, 8-spored; ascospores 12–15 × 6–8 μ, polaribilocular, the cells separate and uninucleate, ellipsoidal to somewhat curved, hyaline. At maturity the spores lie free in the gelified ascus, but when young with a distinct protoplasmic sac within the gelified sheath.

Growing on lichens and mosses and on orthoclase-sericite-siderite schist, and often parasitized by *Thelidium Caloplacae*.

Marie Byrd Land: Edsel Ford Range, Skua Gull Peak, *P. Siple & S. Corey 72W-5*, type, *72W-6*, *72W-14*.

Buelliaceae

Thallus crustose to squamose, simple or effigurate, without rhizinae, attached to the substrate by the hyphae of the prothallus or the medulla; cortex variable, evanescent in some species; algae protococcoid; medulla loosely woven, of thin-walled hyphae. Apothecia circular, immersed or sessile, lecideine or lecanorine; paraphyses simple or branched; asci normally 8-spored; spores smoke gray to brown, 2–4-celled or muriform, few-celled by division of one or more middle cells, usually with a thick wall, without a gelified sheath as in Lecideaceae, with which they may be confused. Spermatia short, straight.

KEY TO ANTARCTIC GENERA

Apothecia lecideine...BUELLIA
  Spores 2-celled, occasionally one- or three-celled.
    Thallus not effigurate...*Eubuellia*
    Thallus effigurate...*Diploicia*
  Spores 4-celled or few-celled, muriform, not effigurate.............*Diplotomma*
Apothecia lecanorine...RINODINA
  Hypothecium dark-colored; spores polaribilocular.................*Orcularia*
  Hypothecium hyaline.
    Spore-wall thick.
      Lumen of spore round or with rounded angles...............*Eurinodina*
        Spores 2-celled...*Pachysporaria*
        Spores 4-celled...*Conradia*
      Lumen of spore cordiform or blunt corniform, hyaline until late......
      ....*Mischoblastia*
    Spore-wall thin, no isthmus; spores small, 2-celled.
      Thallus uniform; apothecia immersed..................*Melanaspicilia*
      Thallus effigurate...*Beltraminia*

BUELLIA

Buellia DeNotaris, Giorn. Bot. Ital. II. 1[1]: 195. 1846.

The type species was not designated. Of the three species first treated *B. canescens* (Dicks.) DNtrs. may be eliminated as it belongs in sect. *Diploicia* which is sometimes treated as a separate genus. Of the two remaining in sect. *Eubuellia* Clements & Shear (Gen. Fung. 323. 1931) have chosen *B. parasema* DNtrs.

Thallus crustose, simple, margins sometimes effigurate, seldom squamulose, attached to the substrate by the hyphae of the

medulla or prothallus, without true rhizinae; with a fastigiate cortex often evanescent, or more rarely with a pseudoparenchymatous cortex; algae *Protococcus;* medulla of reticulately woven thin-walled hyphae, occasionally sorediate. Apothecia immersed, appressed or sessile, lecideine, black, without algae; hypothecium usually dark or carbonaceous; paraphyses often capitate, epithecium dark; asci usually 8-spored; ascospores brown to black, ellipsoid or elongate, 2–4-celled or slightly muriform from division of the middle cells (in section *Diplotomma)* with a thick wall and without a sheath (distinction from *Rhizocarpon* of the Lecideaceae).

Three sections are commonly recognized, for characters of which see preceding key. This genus contains the largest number of species of any genus found in the Antarctic, thirty-seven having been reported from the Antarctic Archipelago and ten from South Victoria Land, to which we have added twelve new ones from Marie Byrd Land and King Edward VII Land, and one from the Queen Maud Mts. in South Victoria Land.

KEY TO ANTARCTIC SPECIES

Spores 4-celled to few-celled muriform, not effigurate...............DIPLOTOMMA
  A single species..*B. Siplei*
Spores 2-celled, rarely one- or three-celled, not effigurate..............EUBUELLIA
  Thallus some shade of yellow.
    Thallus yellowish brown.
      Spores 17–25 μ..*B. isabellina*
      Spores 11–17.5 μ.
        Margin digitate, lacinulate; parathecium 30–40 μ; thecium 70–80 μ... ....*B. radians*
        Margin confervoid; parathecium thinner; thecium 90–120 μ......... ....*B. olivaceobrunnea*
    Thallus light yellow.
      Spores 14–20 μ..*B. modesta*
      Spores 10–14 μ.
        Non-assimilative areolae black; apothecium 1 mm.; hypothecium fuscous..*B. adarensis*
        Non-assimilative areolae absent; apothecium 0.27 mm.; hypothecium hyaline or light brown.................................*B. pallida*
        Non-assimilative areolae white; apothecium 0.56 mm............*B. grisea*
    Thallus bright yellow.
      Spores 15–20 μ..*B. Nelsoni*
      Spores over 20 μ.
        Apothecia up to 2 mm. in diameter.........................*B. anisomera*

Apothecia 1 mm. in diameter.
Thallus areolate.. *B. cremea*
Thallus granulose to squamulose......................... *B. inordinata*
Apothecia up to 0.6 mm. in diameter......................... *B. citrella*
Spores up to 16 μ long; areolae yellow.
Tops flat with black margins................................ *B. flavoplana*
Tops rounded, margins not black.
Apothecia up to 0.4 mm. in diameter, assimilative areolae up to 1 mm.. *B. superba*
Apothecia up to 0.8 mm.; assimilative areolae up to 0.75 mm... *B. chrysea*
Apothecia up to 1 mm.; assimilative areolae 2–3 mm., 1.5 mm. high; thallus with small black sterile areolae............... *B. variabilis*
Apothecia up to 1.5 mm.; assimilative areolae 2–3 mm., 0.25 mm. high; thallus with black non-assimilative margin, rugose to confervoid.. *B. tristis*
Thallus of some other color.
Growing over soil and mosses.
Thallus pale or white; ascospores large...................... *B. parasema*
Thallus red-brown or darker; ascospores 11–15 × 4.5–7 μ; hypothecium dark brown.. *B. muscicola*
Saxicolous.
Spores more than 30 μ long.
Thallus brownish white; warts 3–4 mm. high............ *B. subpedicellata*
Thallus pure white; warts much smaller..................... *B. Goudieri*
Spores less than 30 μ long.
Hypothecium hyaline.
Spores more than 20 μ long.
Margin of non-assimilative area not distinct; thallus 1 mm. thick
.... *B. conspicua*
Margin of non-assimilative area black; thallus 0.5 mm. thick....
.... *B. melanostola*
Spores less than 20 μ.
Thallus mainly confervoid.
Assimilative areolae white; apothecium 0.6 mm.; spores 9–12 × 5–7 μ.. *B. stellata*
Assimilative areolae olive brown.
Apothecium 0.25 mm.; spores 12–14 × 8–10 μ... *B. pycnogonoides*
Apothecium 0.33 mm.; spores 9–9.5 × 5.5–6.5 μ... *B. brunnescens*
Thallus of small white separate areolae; spores 13–15 × 8–9 μ
.... *B. evanescens*
Thallus of stellate white radiating strands; spores 8–10 × 4–6 μ
.... *B. alboradians*
Thallus continuous or nearly so.
Thallus white, light gray or brown, areolate.
Spores 16–20 × 5.5–7 μ.......................... *B. Russellii*
Spores 11–13(–16) × (8–)9–11 μ................ *B. dimorphota*
Spores 10–15.5 × 5.5–7 μ......................... *B. grisea*
Spores 8–9.5 × 4.5–6 μ........................... *B. floccosa*

Thallus and apothecia black.
Assimilative thallus tuberculate and continuous, showing little non-assimilative thallus; spores 10–12 × 6–8 μ.... ....*B. pernigra*
Assimilative thallus scattered, tuberculate; non-assimilative thallus well developed, continuous or reticulate toward the margin; spores 8–10(–13) × 5–6(–7.5) μ...*B. dendritica*
Hypothecium brown.
Margin of non-assimilative thallus white.............*B. latemarginata*
Margin of non-assimilative thallus brownish.
Thallus thick, brown.................................*B. augusta*
Thallus thin, whitish............................*B. protothallina*
Margin of non-assimilative thallus not as above.
Margin indistinct.
Spores less than 16 μ long.
Thallus thick, maculate............................*B. frigida*
Thallus thin.
Thallus continuous............................*B. quercina*
Thallus not continuous, whitish....................*B. albida*
Spores 16–28 μ.
Thallus white...............................*B. imperfecta*
Thallus brownish.................................*B. russa*
Thallus not as above.
Apothecia up to 0.4 mm........................*B. polychroa*
Apothecia up to 1 mm.......................*B. melampoa*
Spores up to 28 μ.............................*B. dichromatina*
Margin distinct.
Margin dendritic.
Thallus whitish.
Spores brown..................................*B. Gainii*
Spores black.
Margin 2–3 mm. broad.....................*B. margaritae*
Margin 5–6 mm. broad.....................*B. Liouvillei*
Thallus grayish.
Spores black..................................*B. Tuxenii*
Spores brownish.
Hypothecium black..................*B. caesiocinerescens*
Hypothecium brownish.
Thallus up to 0.8 mm. thick..................*B. perlata*
Thallus up to 1 mm. thick................*B. endomelaena*
Margin not dendritic.
Spores over 20 μ long.
Spores black.............................*B. Petermanni*
Spores not black.
Non-assimilative margin very narrow......*B. acarosporoides*
Non-assimilative margin up to 1 mm.........*B. festivissima*
Spores less than 20 μ long.
Thallus up to 0.5 mm. thick.
Apothecia up to 1 mm. in diameter..........*B. actinoloba*

Apothecia up to 0.5 mm. in diameter.........*B. brabantica*
Thallus much thinner.
Thallus dark gray............................*B. Charcoti*
Thallus brownish............................*B. Joannae*

BUELLIA **Siplei** Dodge & Baker, sp. nov.
Pl. 60, figs. 376–377; pl. 61, figs. 378–380.

Type: Marie Byrd Land, Edsel Ford Range, Mt. Rea-Cooper, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff R-6.*

Thallus inter muscos in solo, inconspicuus, albus vel brunnescens, gelifactus madefactus, mollis, crustosus vel granulosus; cortex superior cellulis fastigiatis, superficie subobscurascente; stratum gonidiale basale, circa 160 μ crassitudine, algis abundantibus parvis, ad 3 μ diametro; medulla 350 μ crassitudine, hyphis hyalinis, circa 2 μ diametro, laxe reticulatimque dispositis, circum algas compactioribus; cortex inferior cortici superiori similis, saepe cum cephalodiis hypogenis Rivulariaceis, ad 150 μ crassitudine sub thallo apotheciisque.

Apothecia ad 1.5 mm. diametro, plerumque circa 0.45 mm. diametro, irregularia, applanata vel concava, marginata, subnitida, grisea vel nigra, rara; parathecium 20–30 μ crassitudine, pseudoparenchymaticum, cellulis ad 7 μ diametro, obscuris pachydermaticisque, in hypothecium mergens; hypothecium ad 25 μ crassitudine, cellulis obscure brunneis reticulatis compactis; thecium ad 50 μ altitudine; paraphyses ad 0.75 μ diametro, graciles, ramosi, gelifacti, apicibus non inflatis, hyalinis; epithecium 8–15 μ crassitudine, gelifactum, obscure brunneum; asci 38–47 × 11–15 μ, elongato-clavati vel maturitate late-clavati, apicibus vaginatis; ascosporae 15–26 × 4–5 μ, ovoideae dein elongatae, 2–8-cellulares, frequenter 4-cellulares, obscure brunneae.

Assimilative areolae over areas of a few mm. among mosses on soil and gravel, inconspicuous, white to brownish, gelified when moist, soft, crustose to granulose; upper cortex represented by scattered fastigiate cells slightly darkened at the outer edges; algal layer basal, about 160 μ thick, cells very numerous, small, up to 3 μ in diameter; medulla 350 μ thick, of loosely reticulate hyaline hyphae about 2 μ in diameter, more compact about the algal cells; basal cortex not morphologically differentiated from the upper cortex, consisting of a few scattered fastigiate cells, sometimes with extensive hypogenous cephalodia of *Rivularia,* up to 150 μ thick, below the thallus and the apothecia.

Apothecia up to 1.5 mm., usually about 0.45 mm. in diameter, irregular, flat to concave, margined, somewhat shining, gray to black, not numerous; parathecium 20–30 μ thick, of large dark thick-walled cells up to 7 μ in diameter, pseudoparen-

chymatous, extending evenly about the apothecium and merging with the hypothecium below; hypothecium up to 25 μ thick, of small dark brown cells, reticulate, compact, thinning laterally to merge with the parathecium; thecium about 50 μ tall; paraphyses about 0.75 μ in diameter, slender, branching, not much inflated at the tips, closely united in a gel, hyaline, not darkened on the outside; epithecium 8–15 μ, gelified, dark brown; asci 38–47 × 11–15 μ, 8-spored, elongate-clavate, becoming broadly clavate at maturity, gelified sheath prominent over the tip; ascospores 15–26 × 4–5 μ, short-ovoid at first becoming elongate with one end tapering, divided transversely into from 2 to 8 (mostly 4) cells, dark brown.

On soil and sericite-orthoclase schist.

MARIE BYRD LAND: Edsel Ford Range, Mt. Rea-Cooper, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff R-6*, type; Lichen Peak, *P. Siple & S. Corey 73-7.*

BUELLIA **olivaceobrunnea** Dodge & Baker, sp. nov.

Pl. 58, figs. 340–347.

Type: Marie Byrd Land, Edsel Ford Range, Skua Gull Peak, *P. Siple & S. Corey 72W-15.*

Thallus non assimilans 1–3 × 0.5–2.5 cm., adpressus, marginatus, saepe tenuescens, non elevatus, confervoideus, raro albomaculatus, cellulis emortuis corticalibus, continuus, niger; cortex superior ad 30 μ, cellulis sphericis non angularibus; medulla hyphis reticulatis; stratum basale cellulis sphericis; areolae assimilantes ad 0.5 mm., pustulares aut elongatae, irregulares, angulares applanataeque, raro radiatim diffractae, gregariae, sparsae aut etiam singulae in area centrali, obscure olivaceo-brunneae vel citrino-ravae; cortex superior 10–30 μ, fastigiatus, capitatus, cellulis magnis pachydermaticis in duobus vel tribus stratis evanescentibus; stratum gonidiale 50 μ, cellulis ad 7 μ diametro; medulla 100–150 μ, reticulata; stratum basale 10–30 μ, cellulis sphericis.

Apothecia ad 0.5 mm. diametro, circularia, raro angularia, emarginata, unum vel plura in quaque areola, gregaria vel immersa, sessilia, nigra; cortex medullaque desunt; hypothecium 50–100 μ crassitudine centro, ad margines tenuescens, obscurum, reticulatum, basi subsolido; thecium 90–120 μ crassitudine; paraphyses 2–4 μ, ramosi, apicibus non inflatis, obtusi, cellulis pachydermaticis vaginatis, epithecium 5–8 μ crassitudine, obscurum; asci (50–)70–96 × (14–)18–28 μ, elongati, clavati, vaginati; ascosporae octonae, 13–17.5 × 6–11 μ, uniseptatae, raro aseptatae, obtusae vel longiores et acutae, constrictae, obscurae.

Non-assimilative portions covering areas 1–3 × 0.5–2.5 cm. closely applied to the rock, margin distinct, often thinning out, not raised, confervoid, occasionally with whitish patches of dead cortical cells, usually continuous and making a conspicu-

ous border, black; upper cortex about 30 μ, of spherical cells not angled by pressure but making a compact tissue; medulla of similar cells in a very loose open network; basal layer similar to the upper cortex; assimilative areolae up to 0.50 mm., pustular and circular in outline or irregularly elongate, angular and flattened, sometimes radially cracked, often showing a thin encrusting black layer on the upper surface and in older collections entirely blackened, massed or scattered to single in central portion, dark olive brown to citrine drab; upper cortex 10–30 μ thick, of two or three layers of thick-walled cells which disappear, leaving a palisade of small thin-walled, compact cells without a definite outer zone; algal layer 50 μ thick, cells up to 7 μ in diameter; medulla 100–150 μ, of loose hyphae in a definite reticulate arrangement; basal layer 10–30 μ, similar to the basal layer of the non-assimilative portions.

Apothecia up to 0.5 mm., usually circular in outline, sometimes angled by mutual pressure, without a prominent rim, one to several on an assimilative areola, usually gregarious, sessile or immersed; cortex and medulla absent; parathecium a few differentiated cells merging laterally into the cortex of the thallus; hypothecium 50–100 μ thick at the center, thinning toward the parathecium, dark, of close reticulations, almost solid at the base; thecium 90–120 μ thick; paraphyses 2–4 μ, only slightly inflated at the tips, often much branched, blunt with a dark encrusting layer on the outer surface, cells thick-walled, sheath conspicuous, epithecium 5–8 μ thick, dark; asci (50–)70–96 × (14–)18–28 μ, 8-spored, very elongate-clavate, with well-developed sheath (size is very variable but spores from the same collection are very constant despite this variation); ascospores 13–17.5 × 6–11 μ, 2-celled although occasionally not divided, blunt to more elongate and pointed (variations occur in the same section), constricted at the septum or not, dark.

On coarse-grained pink granite, quartzite, and dark greenish-gray slate.

King Edward VII Land: Rockefeller Range, Mt. Helen Washington, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff HW-15.*

Marie Byrd Land: Edsel Ford Range, Skua Gull Peak, *P. Siple & S. Corey 72W-7, 72W-15,* type, *72W-16;* Mt. Stancliff, *P. Siple & S. Corey 72A-2.*

BUELLIA **pallida** Dodge & Baker, sp. nov. Pl. 56, figs. 318–321.
Type: Marie Byrd Land, Edsel Ford Range, Haines Mts., *P. Siple & F. A. Wade H-3.*

Areolae assimilantes sparsae vel gregariae, ad 2–5 mm. diametro, irregulares, subpulvinatae, ad 0.25 mm. longitudine, dilute luteae vel albidae, nigro-marginatae, cortex ad 10 μ crassitudine, hyphis brunneis magnis; algae sparsae; medulla 120–150 μ crassitudine, hyphis laxe implexis; stratum basale circa 10 μ crassitudine, non bene evolutum obscurius compactiusque.

Apothecia circa 0.27 mm. diametro, sessilia, applanata vel concava, marginata, rara, nigra, carbonacea; cortex 18–20 μ crassitudine, niger, pseudoparenchymaticus; parathecium non bene evolutum; hypothecium 40–50 μ, tenuescens et cum cortice concrescens, hyalinum vel dilute brunnescens; thecium circa 50–55 μ altitudine; paraphyses 1–1.5 μ, capitibus circa 3 μ diametro, nigrescentibus, ramosi vel non ramosi, epithecium circa 5 μ, obscurum; asci 30–40 × 13–20 μ, late clavati; ascosporae (9–)10–13 × 5–6.5 μ, octonae, uniseptatae, raro septo constrictae, obtusae, obscurae.

Non-assimilative portions of thallus not developed; assimilative areolae scattered or gregarious, covering areas up to 2–5 mm., irregular in outline, somewhat pulvinate, up to 0.25 mm. long, pale yellowish to white, usually black-margined; cortex of coarse dark hyphae up to 10 μ thick; medulla of loose spongy tissue, 120–150 μ; algae scattered; basal layer about 10 μ thick, not much differentiated from the medulla but slightly darker and more compact.

Apothecia about 0.27 mm. in diameter, circular, sessile, flat or concave, margined, black, carbonaceous, rare; cortex 18–20 μ thick, black, pseudoparenchymatous; medulla about 35 μ thick above the algae which gradually die out in the center under the apothecium and persist along the margin, of the same texture as that of the thallus; parathecium not well differentiated; hypothecium 40–50 μ thick in the center, tapering laterally until it merges with the cortex, hyaline or very pale brown, of compact periclinal hyphae; thecium about 50–55 μ tall; paraphyses 1–1.5 μ, expanding to heads about 3 μ in diameter, branched or unbranched, epithecium dark brown, about 5 μ thick; asci 30–40 × 13–20 μ, 8-spored, short, broadly clavate, shortening with maturity as the contents swell; ascospores (9–)10–13 × 5–6.5 μ, 2-celled, rarely constricted at the septum, mostly blunt, dark brown.

On pitted sericite schist, brownish with iron.

MARIE BYRD LAND: Edsel Ford Range, Haines Mts., *P. Siple & F. A. Wade H-3*, type.

BUELLIA **grisea** Dodge & Baker, sp. nov. Pl. 59, figs. 354–357. Type: Marie Byrd Land, Edsel Ford Range, Haines Mts., *P. Siple & F. A. Wade H-1.*

Thallus non assimilans ad 1.5 cm. diametro, radiatus, saxicola, lobatus, griseus vel albus, marginibus nigris; cortex fastigiatus, cellulis brunneis, insuper evanescens; medulla laxa, cellulis irregularibus; stratum basale pseudoparenchymaticum, obscurum; areolae assimilantes lobatae, ad 1.75 mm. diametro, irregulares, dichotome ramosae, marginibus impendentibus, radiatim diffractae, ad centrum thalli diffusae sparsaeque, albae, lutescentes vel griseae, marginibus dilutioribus; cortex fastigiatus, in apicibus areolarum evanescens; stratum gonidiale 60 μ, coloniis 14–16 μ diametro, sparsis, protococcoideis; medulla 35–40 μ crassitudine, hyphis laxe implexis; stratum basale non bene evolutum, cellulis obscurioribus.

Apothecia ad 0.56 mm. diametro, irregulariter hemispherica, convexa, sessilia singulaque quoque in areolis, sparsa, nigra, carbonacea; cortex cellulis pachydermaticis, pseudoparenchymaticus; hypothecium ad 50 μ crassitudine, non tenuescens; parathecium deest; thecium 60–70 μ; paraphyses 1–1.5 μ, apicibus ad 2 μ, nigro-incrustatis; asci 36–46 × 14–16 μ, elongato-clavati, vaginati; ascosporae octonae, uniseptatae, 10–13.5 × 5.5–7 μ, brunneae.

Non-assimilative thallus up to 1.5 cm. in diameter, radiate, saxicolous, lobed, gray to white, margins black; cortex fastigiate, of dark cells thinning out over the tops of the lobes; medulla of loose irregular hyphae; basal layer represented by scattered dark isodiametric cells; assimilative thallus of distinct lobes up to 1.75 mm. across, irregular, often dichotomously branched, overhanging at the margins, radiately cracked, becoming diffused and scattered toward the center, white to yellowish or gray, margins usually lighter in color; cortex fastigiate, breaking away over the tops of the areolae; algal layer 60 μ, colonies 14–16 μ, scattered, protococcoid; medulla 35–40 μ thick, of loosely woven hyphae; basal layer not well developed, occasionally represented by a few dark cells; often sterile, but thalline characters are sufficient for identification.

Apothecia up to 0.56 mm. in diameter, irregularly hemispheric, convex, sessile on the areolae, black, carbonaceous; cortex of thick-walled pseudoparenchyma; hypothecium up to

50 μ thick, not thinning; parathecium only a few cells or not differentiated; thecium 60–70 μ; paraphyses 1–1.5 μ, slightly expanded up to 2 μ at the tips with heavy black incrustations at the outer edges, unbranched or branched, epithecium about 10 μ, dark; asci 36–46 × 14–16 μ, elongate-clavate with a sheath, 8-spored; ascospores 10–13.5 × 5.5–7 μ, with or without a constriction at the septum, blunt or slightly tapering.

On sericite schist, biotite-sericite, orthoclase-sericite schist, brownish with iron.

Marie Byrd Land: Haines Mts., *P. Siple & F. A. Wade H-1*, type, *H-2*; Mt. Donald Woodward, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff DW-5*; Garland Hershey Ridge, *P. Siple & S. Corey 5-2.*

Buellia flavoplana Darbishire, Brit. Antarct. [Terra Nova] Exp. Bot. **3**: 38. 1923. Pl. 55, figs. 297–302; pl. 65, fig. 424.

Illustrations: Darbishire, *Ibid.* p. 38, *f. 6; pl. 1, f. 3.*

Type: South Victoria Land, Cape Adare, British Antarctic [Terra Nova] Expedition in British Museum, not seen.

Thallus closely applied to the rock substratum, covering areas 0.5–2.5 cm. in diameter; non-assimilative portion carbonaceous, black, margin determinate, sometimes as much as 0.9 mm. high or thinning out until the edges are distinctly confervoid, forming a continuous layer of different levels but frequently separating into strands in the interior, the pillars flattened, convex or concave, even conical, 50–500 μ in diameter, 90–220 μ high, often capped with dead, white cortical cells, giving the whole area a grayish color in a more or less definite reticulate pattern in contrast to the pure black margin; upper cortex 20–75 μ thick, of the fastigiate type, the capitate hyphal tips forming a dark pseudoparenchymatous layer two or three cells deep, merging gradually with the medulla; over the pillars the cortical cells die, become hyaline and no longer staining with the usual dyes; medulla of loosely woven hyaline hyphae 2–3 μ in diameter; assimilative areolae 0.65–1.35 mm. in diameter or elongate and up to 1.6 mm. long, those sectioned 290–1100 μ in diameter, 90–400 μ tall, chartreuse yellow to whitish, the surface decorticate above, hence slightly floccose, flattened, scattered or so closely associated that they become angu-

lar by mutual pressure; upper cortex continuous with that of the non-assimilative portion, extending only a short way over the edges of the areolae (when young the cortical rim is so pronounced that the areolae appear immersed in the thallus and when an assimilative areola is secondarily divided by cracks, the cortex is completely lacking in the cracks); algal layer 30–40 μ thick, cells protococcoid, mostly in vertical rows, spherical, 7–8 μ in diameter, sheaths up to 14 μ; medulla of loosely associated hyphae continuous with that of the non-assimilative portion, often compactly united in vertical columns which penetrate the algal layer; basal layer 10–15 μ thick, less distinct than the upper cortex, of a few rows of dark cells densely packed.

Apothecia scattered or gregarious, convex to irregularly spherical on separate pillars, sometimes almost stalked, usually sessile to subsessile, 0.22–1.3 mm. in diameter, commonly about 0.67 mm., convex when young with an equatorial fringe of dead, white cortical cells, becoming flattened, usually with a conspicuous margin, sometimes emarginate; cortex and medulla continuous with those of the thallus and of the same texture; parathecium not differentiated; hypothecium of dark closely associated cells, about 40 μ thick at the center, 25 μ at the sides, and disappearing upwards; thecium 60–90 μ thick; paraphyses 2–4 μ in diameter, branched or straight, not capitate, ending in a dark brown epithecial gel 8–10 μ thick, cells short, thick-walled, the whole gelified; asci elongate, broadly clavate, with a prominent gelified sheath, 8-spored, 45–55 × 18–20 μ; ascospores dark, 2-celled with blunt ends, slightly constricted at the septum, sometimes undivided but approximately the same size, 10–16 × 7–9 μ, one cell of the spore sometimes exceeding the other in size.

The assimilative areolae are easily the most conspicuous part of this lichen for they contrast strikingly with the black thallus. Darbishire reported no apothecia exceeding 1 mm., but several larger ones were found in these collections.

On biotite-sericite schist.

MARIE BYRD LAND: Edsel Ford Range, Mt. Donald Woodward, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff DW-3, DW-5.*

BUELLIA **chrysea** Dodge & Baker, sp. nov.

Pl. 56, figs. 308–311, 316–317.

Type: Marie Byrd Land. Edsel Ford Range, Mt. Rea-Cooper, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff R-7.*

Thallus appressus, radians 2–4 mm. diametro, pars non assimilans ad 150 μ crassitudine, nigra; cortex medullaque non bene evoluta, extus nigra, intus hyalina, continua vel dissecta reticulataque juventute; areolae assimilantes ad 0.75 mm. diametro, pustulares, floccosae, irregulares, "marguerite yellow," angulatae, sparsae vel gregariae; cortex fastigiatus, cellulis magnis brunneis, in superficie evanescens et amorphus; stratum gonidiale coloniis sparsis in media vel in basi medullae; medulla hyphis tenuibus laxe reticulatimque implexis, sub apotheciis hyphis brunneis majoribus; stratum basale cellulis parvis brunneis compactius sed plus minusve reticulatum, ad 15 μ crassitudine.

Apothecia ad 0.8 mm. diametro, spherica convexave, marginibus subcrenulatis, sessilia, nigra; cortex 10–15 μ crassitudine, cellulis magnis fastigiatis; hypothecium ad 150 μ crassitudine, obscurissimum, cellulis magnis brunneis reticulatim dispositis; thecium 90–100 μ crassitudine; paraphyses 1–2 μ crassitudine, capitibus ad 6 μ diametro, ramosi, apicibus obscuris, epithecium 10–18 μ, nigrum, rugosum; asci 45–65 × 15–18 μ, clavati, basi longa attenuataque; ascosporae 10–12 × 5.5–7 μ, octonae, uniseptatae, obtusae vel subacutae, brunneae.

Thallus closely attached, spreading more or less radiately over areas of 2–4 mm.; non-assimilative portion up to 150 μ thick, black, dull, cortex and medulla not morphologically differentiated but external layers black, hyaline within, continuous or dissected and reticulate especially in younger stages; assimilative areolae up to 0.75 mm. in diameter, pustular, floccose, irregular, marguerite yellow, angled by pressure when close together, scattered or gregarious; upper cortex not well defined except at the margins of the areolae, fastigiate, of large dark cells not covering the surface of the areolae which is amorphous; algal colonies scattered through the middle and basal portion of the medulla, of reticulate loosely woven hyphae (below the apothecia darker and coarse); basal layer of slightly darkened cells, small, rather compact although more or less reticulate, up to 15 μ.

Apothecia up to 0.8 mm., spherical, convex, with a distinct margin sometimes slightly crenulate, sessile, black, dull; cortex 10–15 μ thick, of large fastigiate cells; hypothecium up to 150 μ thick, very dark, of coarse brown cells in a close reticulum; thecium 90–100 μ tall; paraphyses 1–2 μ in diameter, expand-

ing to heads up to 6 μ in diameter, usually branched, the outer surfaces of the apices darkened, epithecium 10–18 μ, black and rugose; asci 45–65 × 15–18 μ, 8-spored, especially long and slender, clavate, and expanded above, the base remaining attenuate; ascospores 10–12 × 5.5–7 μ, 2-celled, not always constricted at the septum, blunt to somewhat pointed, dark.

On coarse-grained granite.

MARIE BYRD LAND: Edsel Ford Range, Mt. Rea-Cooper, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff R-7*, type.

BUELLIA **muscicola** Dodge & Baker, sp. nov.

Pl. 59, figs. 348–353.

Type: King Edward VII Land, Rockefeller Mts., Mt. Helen Washington, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff HW-2, HW-10.*

Thallus non assimilans 1.75 × 0.7 cm., conspicuus, tenuiter dendritice ramosus, obscure rufo-brunneus vel niger, marginibus funiculorum principalium asperatis, ramis brevibus, cellulis obscuris, irregularibus, cortice medullaque non evolutis sed cellulis interis nonnumquam hyalinis; areolae assimilantes ad 0.33 mm., pallidae vel rufo-brunneae, gelifactae, sparsae vel gregariae ad confluentiam funiculorum; cortex mox evanescens; stratum gonidiale in medio thalli, ad 60 μ crassitudine, cellulis 4 μ diametro; medulla hyphis laxe implicatis; stratum basale non evolutum; bulbilli ad 75 μ diametro, spherici, obscuri, numerosi, sparsi vel gregarii, cellulis brunneis pseudoparenchymaticis.

Apothecia ad 0.57 mm. diametro, applanata vel subspherica, nonnumquam marginata, convexa, sessilia vel substipitata, sparsa vel gregaria, nigra, carbonacea; cortex ad 20 μ, bene evolutus, cellulis magnis brunneis; hypothecium 20–50 μ, obscure brunneum; thecium ad 80 μ altitudine; paraphyses 1.5–2 μ, ramosi, capitati, 7–8 capitibus in quoque paraphyse, cellulis 5 μ diametro, brunneis, epithecium ad 10 μ, obscurum, asperum; asci 31–50(–57) × 14–17 μ, clavati, vaginati; ascosporae octonae, 11–15(–17) × 4.5–7 μ, uniseptatae, non constrictae, acutae, distichae juventute, dein irregulares.

Non-assimilative portion 1.75 × 0.7 cm., on rocks or soil among mosses, conspicuous but very slender, branched, spreading, dark reddish brown to black, the edges of the main strands roughened by short side branches, of dark irregular cells; cortex and medulla not differentiated, but the inner cells sometimes hyaline; the assimilative areolae up to 0.33 mm., pale to red brown, pustular, gelified, especially abundant and prominent at the confluence of the non-assimilative branches, gregarious or scattered; cortex soon evanescent; algal layer proto-

coccoid, about 60 μ thick in the middle of the thallus, cells about 4 μ in diameter; medulla of loosely woven hyphae somewhat more developed and more compact under the apothecia; lower cortex not differentiated; asexual reproduction on the non-assimilative portions of the thallus by bulbils up to 75 μ in diameter, spherical, dark, numerous, scattered or in groups, pseudoparenchymatous, of dark cells.

Apothecia up to 0.57 mm. in diameter, flattened to almost spherical, sometimes marginate, usually convex, sessile to substipitate, scattered or gregarious, black, carbonaceous; cortex up to 20 μ thick, well developed, of large dark cells; hypothecium 20–50 μ, dark brown, parathecium not differentiated although a few cells can be traced from the margin of the hypothecium to the cortex; thecium up to 80 μ; paraphyses 1.5–2 μ, much branched, the larger expanded, heads arranged in a group of 7–8 suggesting a candelabrum, individual heads about 5 μ in diameter, the walls darkened with a brown cap, epithecium up to 10 μ, dark, rough; asci 31–50(–57) × 14–17 μ, 8-spored, clavate, with a gelified sheath; ascospores 11–15(–17) × 4.5–7 μ, 2-celled, not constricted, pointed, nearly distichous when young, irregularly distributed at maturity.

In our preliminary study of this material, we separated that from Marie Byrd Land as a distinct species, since it differs in longer, narrower asci in all stages of development and in slightly larger spores with greater development of the non-assimilative portions; but without a more precise knowledge of the range of variation from a study of more material than is available, we are inclined to regard them as conspecific.

On soil, quartz crystals, and sericite-orthoclase schist.

King Edward VII Land: Rockefeller Mts., Mt. Helen Washington, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff HW-2, HW-7, HW-10*, type.

Marie Byrd Land: Edsel Ford Range, Haines Mts., *P. Siple & F. A. Wade H-3*; Skua Gull Peak, *P. Siple & S. Corey 72W-9, 72W-13*; Lichen Peak, *P. Siple & S. Corey 73-1.*

Buellia **stellata** Dodge & Baker, sp. nov.

Pl. 55, fig. 303; pl. 56, figs. 304–307.

Type: Marie Byrd Land, Edsel Ford Range, Haines Mts., *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff DW-3.*

Thallus parvus, appressus, saxicola; pars non assimilans radians ex partibus assimilantibus vel apotheciis, funiculosa, cellulis nigris vel in funiculis magis evolutis etiam cellulis medullaribus laxis; areolae assimilantes ad 0.33 mm., hemisphericae vel elongatae, applanatae, singulae vel binae ternaeve, albae vel sordidae, lateribus nigrescentibus per extensionem cellularum corticarum nigrarum ex funiculis; cortex ad 5 μ crassitudine, cellulis brunneis nigrisve, insuper strato cellularum hyalinarum emortuarum tectus; stratum gonidiale ad 40 μ crassitudine, cellulis in coloniis plus minusve sphericis, subangularibus, 4–6 μ diametro; medulla circa 60 μ crassitudine, spongiosa, hyphis verticalibus laxissime intertextis; latera stratumque basale, cellulis plus minusve isodiametricis, insuper in cortice mergentibus.

Apothecia ad 0.6 mm. diametro, circularia, applanata vel subdepressa, submarginata, sessilia vel in areolas assimilantes immersa, omnino areolas tegentia aut saepe annulum album equatorialem reliquentia, singula, nigra, carbonacea; cortex medullaque non evoluta; hypothecium hyalinum vel subbrunneum, 15–22 μ crassitudine, lateraliter tenuescens; thecium 50–70 μ altitudine; paraphyses 1–1.5 μ, apicibus 1.5–2.5 μ diametro, recti vel ramosi ad apices, epithecium 5–7 μ crassitudine, obscurum, KOH viridescens; asci 36–46 × 12–16.5 μ, obtuse clavati; ascosporae octonae, 9–12 × 5–7 μ, obscure brunneae, obtusae, uniseptatae, ad septum constrictae.

Thallus very small and firmly attached to rock; non-assimilative portion dull black, thinly effused, radiating in a stellate pattern from either assimilative areolae or apothecia, composed of simple strands of black cells, or in thicker better-developed areas with loose medullar cells in addition; assimilative areolae up to 0.33 mm., subhemispherical to elongate, flattened, usually single or two or three in a group, white or dingy, sides more or less blackened by the extension of the black cortical cells from the non-assimilative regions; upper cortex about 5 μ thick, sometimes of dark brown or black fastigiate cells, above which is frequently a layer of dead colorless cells; algal layer up to 40 μ thick, cells arranged in more or less spherical colonies, somewhat angular, 4–6 μ in diameter; medulla about 60 μ thick, spongy, of loosely woven hyphae predominantly vertical; sides and basal layer of dark more or less isodiametric cells merging into the fastigiate cortex above.

Apothecia up to 0.6 mm., circular in outline, flattened or slightly depressed with a slight rim, sessile upon or sunk in the assimilative areolae, usually covering them completely although often leaving an equatorial white rim, usually single, black, carbonaceous; cortex and medulla not developed; hypo-

thecium hyaline or faintly tinged with pale brown, 15–22 μ thick, thinning laterally; thecium 50–70 μ thick; paraphyses 1–1.5 μ in diameter, expanding to 1.5–2.5 μ at the tips, straight or rarely branched near the tips, the ends sometimes darkened by a heavier encrusting layer on the outer surfaces, epithecium 5–7 μ thick, dark, giving a faint greenish reaction with KOH; asci 36–46 × 12–16.5 μ, bluntly clavate, 8-spored; ascospores 9–12 × 5–7 μ, dark brown, two-celled, blunt, somewhat constricted at the septum.

On coarse-grained gray granite, granodiorite, sericite-orthoclase schist, biotite-sericite, and orthoclase-sericite-siderite schist.

MARIE BYRD LAND: Edsel Ford Range, Mt. Donald Woodward, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff DW-3*, type, *DW-5;* Haines Mts., *P. Siple & F. A. Wade H-2;* Mt. Rea-Cooper, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff R-7;* Chester Mts., *P. Siple & S. Corey 97A-4;* Lichen Peak, *P. Siple & S. Corey 73.*

BUELLIA **brunnescens** Dodge & Baker, sp. nov.

Pl. 56, figs. 312–315.

Type: Marie Byrd Land, Edsel Ford Range, Mt. Rea-Cooper, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff R-1.*

Thallus non assimilans tenuissimus, stellatus, niger vel obscure brunneus, cellulis internis verticalibus laxe implexis, exteris isodiametricis; areolae assimilantes ad 0.45 mm. diametro, ellipsoideae subsphericaeve subapplanataeque, sparsae, olivaceo-brunneae vel sordidae vel etiam obscurissimae; cortex superior super stratum gonidiale hyalinus, strato singulo cellularum isodiametricarum, lateralis niger, uno vel pluribus stratis cellularum isodiametricarum; stratum gonidiale protococcoideum, ad 30 μ crassitudine, coloniis subsphericis et cellulis singulis; medulla 100–120 μ, irregulariter laxe contexta; stratum basale 20–30 μ crassitudine, obscurum, pseudoparenchymaticum.

Apothecia ad 0.33 mm., subspherica, applanata, sessilia, immersa, rare concava vel marginata, singula, nigra; cortex, medulla paratheciumque desunt; hypothecium 5–8 μ crassitudine, hyalinum vel subbrunneum; thecium 50–65 μ altitudine; paraphyses 1–1.5 μ, ramosi vel non ramosi, non inflati, apicibus callosis, epithecium circa 5 μ crassitudine; asci 43–48 × 12–14 μ, elongati, clavati, vaginati; ascosporae octonae, 9–9.5 × 5.5–6.5 μ, uniseptatae, subconstrictae, obtusae, obscuriores.

Thallus extremely delicate, of very fine straight threads spreading from assimilative areolae or apothecia, black or dark brown, not differentiated into cortex and medulla, the internal cells dark, in a more or less vertical, loosely woven tissue, the

outer cells pseudoparenchymatous; assimilative areolae up to 0.45 mm. in diameter, ellipsoidal or subspherical, pustular or more or less flattened, scattered, olive brown or dingy, sometimes very dark; cortex hyaline over algal zone, of one layer of pseudoparenchymatous cells, lateral cortex of one or more layers of pseudoparenchymatous cells; algal layer protococcoid, up to 30 μ thick, of subspherical colonies and single cells; medulla 100–120 μ, irregularly and loosely woven; basal layer 20–30 μ thick, of dark isodiametric cells.

Apothecia up to 0.33 mm., sessile to immersed, subspherical, flattened above, occasionally concave, marginate, mostly single, black; cortex, medulla, and parathecium not differentiated; hypothecium 5–8 μ thick, scant, hyaline or faintly brownish, not thinning; thecium 50–65 μ tall; paraphyses 1–1.5 μ at the tip, slender, scarcely inflated, branched or straight, tips with a small cap, epithecium about 5 μ thick; asci 43–48 × 12–14 μ, elongate-clavate with a prominent sheath, 8-spored; spores 9–9.5 × 5.5–6.5 μ, 2-celled, slightly constricted at the septum, rather blunt, dark.

On coarse-grained granite.

MARIE BYRD LAND: Edsel Ford Range, Mt. Rea-Cooper, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff R-1*, type, *R-2*.

BUELLIA **alboradians** Dodge & Baker, sp. nov.
Pl. 56, fig. 322; pl. 57, figs. 323–326.

Type: Marie Byrd Land, Edsel Ford Range, Haines Mts., *P. Siple & F. A. Wade H-1*.

Thallus stellatus, parvus, gregarius in areis ad 2 cm. diametro; areolae assimilantes ad 0.33 mm., albae, floccosae, diffractae, nigro-marginatae, angulares, irregulares, applanatae, parviores ad marginem thalli, ultimis in funiculos tenues reticulatos mergentibus; cortex superior 6–7 μ crassitudine, capitati-fastigiatus, cellulis sphericis, brunneis, 3–4 μ diametro, evanescens aut degenerans; stratum gonidiale 40–50 μ, coloniis sphericis ad 15 μ, sparsis, vaginatis, cellulis ad 7 μ; medulla hyphis laxe implicatis; stratum basale compactius, non bene evolutum, raro cellulis nigris sparsis.

Apothecia ad 0.5 mm., irregulariter hemispherica aut applanato-patellaeformia, raro concava, emarginata, nigra, sessilia, sparsa; cortex niger, ad 15 μ crassitudine, pseudoparenchymaticus; medulla paullum evoluta; hypothecium 40–60 μ, hyalinum aut subluteum, hyphis periclinalibus dense contextum, ad marginem tenuescens; paraphyses 1–3 μ, capitibus ad 5 μ diametro, ramosi, juniores non ramosi, apicibus

gelifactis, epithecium 8–15 μ crassitudine, obscurius; asci 36–50 × 13–18 μ, late clavati, vaginati; ascosporae octonae, 8–10(–12) × 4–6(–8) μ, uniseptatae, non constrictae.

Non-assimilative portions of thallus small black confervoid strands; assimilative areolae up to 0.33 mm., radiating in a stellate pattern over small areas of a few mm., or scattered, the entire area not exceeding 2 cm. in diameter, white, rather floccose, crackled, edged with black toward the base, the individual areolae angular, irregular, flattening and diminishing in size at the edges where the marginal segments pass into thin black strands, reticulate or trailing; upper cortex 6–7 μ thick, capitate-fastigiate, cells spherical, 3–4 μ in diameter, disappearing over the tops of the assimilative areolae; algal layer 40–50 μ, of spherical colonies up to 15 μ in diameter, sparingly scattered with broad strands of medullary tissue between, cells up to 7 μ in diameter, with broad sheaths; medulla of loosely woven hyphae; basal layer more compact but not differentiated, rarely with scattered black cells.

Apothecia up to 0.5 mm. in diameter, irregularly hemispheric or more flattened saucer-shaped, rarely concave, without a distinct rim, black, sessile, scattered; cortex black, up to 15 μ thick, pseudoparenchymatous; medulla slightly developed; parathecium not differentiated; hypothecium 40–60 μ thick, hyaline or faintly yellow, of densely woven periclinal hyphae thinning toward the margin; paraphyses 1–3 μ, expanding to heads up to 5 μ in diameter, branched, or unbranched especially when young, tips with thick gelified heads, darker at the outer edges, epithecium 8–15 μ thick; asci 36–50 × 13–18 μ, broadly clavate with a conspicuous sheath, 8-spored; ascospores 8–10(–12) × 4–6(–8) μ, 2-celled, only slightly if at all constricted at the septum, dark, one cell sometimes less blunt than the other, or sometimes non-septate although the spore is as large as the divided spores.

On sericite schist and sericite-orthoclase schist, brownish with iron.

Marie Byrd Land: Edsel Ford Range, Haines Mts., *P. Siple & F. A. Wade H-1*, type, *H-2*, *H-3*; Lichen Peak, *P. Siple & S. Corey 73-10*.

BUELLIA **Russellii** Dodge & Baker, sp. nov.

Pl. 60, figs. 370–375.

Type: South Victoria Land, Queen Maud Mts., Durham Mt. at northeast portal of Thorne Glacier, *Q. A. Blackburn, R. S. Russell Jr. & S. D. L. Paine QM-6(6).*

Thallus 1–2 cm. diametro, continuus, tenuis, gelifactus madefactus, granulosus vel subareolatus, albus; cortex deest, superficies paucis cellulis obscurioribus pachydermaticisque aut strato tenui 5–10 μ crassitudine cellularum emortuarum tectus; stratum gonidiale paucis coloniis in parte superiore thalli sparsis, cellulis ad 15 μ diametro; medulla ad 350 μ crassitudine, hyphis ad 4 μ diametro, ramosis, laxe reticulatimque dispositis; stratum basale non evolutum.

Apothecia 0.25 mm. diametro, sessilia, pauca, sparsa, convexa, emarginata, nigra, carbonacea; parathecium non evolutum; hypothecium circa 20 μ crassitudine, hyalinum, compactum; thecium 50–55 μ altitudine; paraphyses 1 μ diametro, capitibus brunneis, ad 4 μ diametro, ad apices ramosi, septati, vaginati, epithecium 5–8 μ, obscurum; asci 55–57 × 18–20 μ, elongati, clavati, maturitate latiores, vagina non prominens; ascosporae octonae, 16–20 × 5.5–7.0 μ, bicellulares, ad septa non constrictae, ellipsoideae vel naviculares vel subcurvatae, obscure brunneae, juventute duobus cellulis sporae isthmo angusto conjunctis.

Non-assimilative portions absent; assimilative portion 1–2 cm. in diameter, continuous, thin, gelified when moist, surface uneven, rather granulose to somewhat areolate, white; upper cortex lacking, the outer surface with occasional darker and heavier-walled cells or with a thin layer of dead cells, 5–10 μ thick; algal layer restricted to a few colonies in the upper parts of the thallus, cells up to 15 μ in diameter; medulla up to 350 μ thick, of freely branched hyphae 4 μ in diameter, loosely and reticulately arranged; lower cortex not differentiated, although the hyphae are sometimes more densely arranged in the surface regions as well as about the algae.

Apothecia small, up to 0.25 mm. in diameter, sessile, few, scattered, convex without a margin, black, carbonaceous; parathecium not differentiated; hypothecium about 20 μ thick, hyaline, not differentiated from the medulla beyond its greater compactness, laterally merging with the margin; thecium 50–55 μ high; paraphyses 1 μ in diameter, expanding to large dark brown heads 4 μ or more in diameter, freely branched near the tips, septate, with a gelified sheath, epithecium 5–8 μ, dark; asci 55–57 × 18–20 μ, 8-spored, elongate-clavate, more broadly so at maturity when distended by spores, sheath not especially

prominent, although appearing in younger stages than in other species; ascospores 16–20 × 5.5–7 μ, 2-celled, not constricted at the septum, ellipsoidal and navicular or slightly curved, dark brown. In young spores a narrow canal can often be seen connecting the two cells.

On white quartz crystals and dark brownish gray schist.

KING EDWARD VII LAND: Rockefeller Mts., Mt. Helen Washington, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff HW-11.*

SOUTH VICTORIA LAND: Queen Maud Mts., Durham Mt. at northeast portal of Thorne Glacier, *Q. A. Blackburn, R. S. Russell Jr. & S. D. L. Paine QM-6(6),* type.

BUELLIA **floccosa** Dodge & Baker, sp. nov.

Pl. 57, figs. 333–334; pl. 58, figs. 336–339.

Type: Marie Byrd Land, Haines Mts., *P. Siple & F. A. Wade H-2.*

Areolae assimilantes abundantes super areas ad 1.5 cm. diametro, appressae, albae vel cremeae, plus minusve floccosae, diffractae, irregulares, marginibus tenuescentibus, subfimbriatis; cortex 15 μ crassitudine, capitati-fastigiatus, cellulis sphericis pachydermaticis brunneis, mox evanescens; stratum gonidiale coloniis paucis sub cortice sparsis, ad 20 μ diametro, non continuum; medulla 100–200 μ crassitudine, funiculis tenuissimis verticalibus ramosisque; stratum basale non bene evolutum, cortici superiori subsimile.

Apothecia ad 0.3 mm. diametro, plerumque multo parviora, convexa vel subdepressa, raro marginata, circularia, applanata, sparsa vel singula, immersa, nigra; parathecium deest; hypothecium ad 45 μ crassitudine, ad marginem tenuescens, hyalinum, hyphis periclinalibus; thecium ad 40 μ; paraphyses 1 μ, capitibus 2–4 μ, ramosi, epithecum circa 8 μ, obscurum; asci 34–40 × 12.5–17 μ, clavati, vaginati; ascosporae 8–9.5 × 4.5–6 μ, octonae, uniseptatae raro non-septatae, subconstricti, obtusae, obscurae.

Non-assimilative portion not differentiated; assimilative areolae abundant over areas up to 1.5 cm., closely attached to the rock, pure white to cream color, more or less floccose, cracked, irregular, margin thinning out, becoming fimbriate in places; cortex 15 μ thick, capitate-fastigiate, of spherical thick-walled yellow-brown cells; algae protococcoid, in small colonies up to 20 μ in diameter just below the cortex, scant and scattered; medulla 100–200 μ thick, of extremely delicate strands of fine hyphae more or less vertical and branching; basal layer not well developed, similar to the upper cortex.

Apothecia up to 0.3 mm. in diameter but usually much smaller, convex to slightly depressed, occasionally with a mar-

gin, circular, scattered or single, immersed, dull to shiny; parathecium absent; hypothecium up to 45 μ thick in the center, thinning laterally and merging with the thalline cortex, hyaline, of deeply staining periclinal hyphae; thecium about 40 μ tall; paraphyses 1 μ in diameter, expanding to inflated tips 2–4 μ, usually repeatedly branched, rarely unbranched, epithecium about 8 μ thick, dark; asci 8-spored, 34–40 × 12.5–17 μ, clavate, with a gelified sheath; ascospores 8–9.5 × 4.5–6 μ, 2-celled, rarely undivided, slightly constricted, small, blunt and dark.

On sericite schist, brownish with iron.

MARIE BYRD LAND: Haines Mts., *P. Siple & F. A. Wade H-2*, type, *H-1*.

BUELLIA **dendritica** Dodge & Baker, sp. nov.

Pl. 59, figs. 358–362; pl. 60, figs. 363–364.

Type: King Edward VII Land, Rockefeller Mts., Mt. Helen Washington, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff HW-18.*

Thallus 5–8 mm. diametro; pars non assimilans ad 50 μ crassitudine, appressa, saxicola, plus minusve continua vel reticulata, marginibus fimbriatis vel dendriticis, nonnumquam paucis funiculis rugosis, nigris; cortex cellulis magnis nigris; medulla non bene evoluta, cellulis hyalinis; stratum basale a cortice non distinctum; areolae assimilantes ad 0.6 mm., circulares vel elongatae, obscure olivaceo-brunneae vel nigrae maturitate, dilutiores juventute, plus minusve pustulares, paucae, sparsae; cortex ad 12 μ crassitudine, cellulis fastigiatis, continuus insuper, cum strato cellularum emortuarum ad 15 μ crassitudine; algae protococcoideae, abundanter per areolas distributae; medulla 50 μ plusve crassitudine, hyphis magnis reticulatim implexis; stratum basale 10–15 μ, pseudoparenchymaticum, brunneum. Apothecia ad 0.33 mm. diametro, subspherica vel applanata, nonnumquam marginibus cellularum albidarum, singula, totam areolam tegentia, nigra, carbonacea; cortex 15 μ crassitudine, cellulis magnis pachydermaticis, cum cortice areolae continuus; hypothecium 20 μ crassitudine, non tenuescens, cellulis leptodermaticis compactum, hyalinum vel dilute brunneum; thecium ad 110 μ altitudine; paraphyses 1 μ, ramosi, capitibus 3 μ, epithecium 10 μ, rugosum, KOH virescens; asci 35–53 × 13–18 μ, elongati, clavati, breviores et crassiores maturitate; sporae octonae (raro senae, quaternae, vel binae, dein sporae majores), 8–10(–13) × 5–6(–7.5) μ, uniseptatae, subconstrictae, subacutae vel obtusae, brunneae.

Thallus covering areas 5–8 mm. in diameter, closely attached to the rock; non-assimilative areas 50 μ thick, more or less continuous but sometimes rather open-reticulate, margins fimbriate or dendritic, or sometimes of only a few rugose strands,

black; cortex of large dark cells a few rows in extent; medulla not differentiated morphologically but composed of a looser arrangement of hyaline cells; basal layer not distinct from the upper cortex; assimilative areolae up to 0.6 mm., circular to elongate, dark olive-brown to black at maturity, much lighter when young, more or less pustular, few and scattered; cortex up to 12 μ thick, well developed, of large fastigiate cells continuous over the top, the outer surface with an extensive layer of dead cells up to 15 μ thick; algae abundant, scattered throughout the areolae; medulla 50 μ or more thick, of coarse hyphae more or less reticulately woven; basal layer 10–15 μ thick, of compact brownish pseudoparenchyma.

Apothecia up to 0.33 mm. in diameter, small, subspherical to flattened, sometimes with a faint margin of whitish cells, usually single, covering the whole areola, black, carbonaceous; cortex 15 μ thick, of thick-walled dark cells continuous with the cortex of the areola; parathecium of a few cells merging with the cortex; hypothecium about 20 μ thick, an even layer not tapering, of closely united thin-walled cells, hyaline or faintly tinged brown; thecium up to 110 μ thick; paraphyses tapering from a little more than 1 μ to heads 3 μ or more, often much branched with heads in clusters, slightly darkened on the outer surfaces, epithecium about 10 μ thick, rugose, dark, giving a faint greenish reaction with KOH; asci 35–53 × 13–18 μ, elongate-clavate, becoming shorter and stouter at maturity when the spores distend them appreciably, 8-spored (but occasionally 6-, 4-, or 2-spored, with a corresponding increase in size of the ascospores); ascospores 2-celled, 8–10(–13) × 5–6(–7.5) μ, somewhat constricted at the septum, sometimes undivided, slightly pointed or blunt, dark brown.

On quartz crystals, leucogranite, granodiorite, biotite sericite, and dark greenish gray slate.

KING EDWARD VII LAND: Rockefeller Mts., Mt. Helen Washington, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff HW-18*, type, *HW-9*, *HW-11* (sterile.)

MARIE BYRD LAND: Edsel Ford Range, Mt. Rea-Cooper, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff R-1, R-2, R-7, R-26-27;* Skua Gull Peak, *P. Siple & S. Corey 72W-9, 72W-11, 72-16* (in close association with *Buellia albida);* Chester Mts., *P. Siple & S. Corey 97A-4;* Mt. Donald Woodward, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff DW-5.*

BUELLIA FRIGIDA Darbishire, Brit. Nat. Antarct. [Discovery] Exp. Nat. Hist. 5: Lichenes, 7. 1910.

Pl. 57, figs. 327–332, 335; pl. 65, fig. 427.

Illustrations: Darbishire, *Ibid. pl. 1, f. 4;* Brit. Antarct. [Terra Nova] Exp. Bot. 3: *pl. 1, f. 5, 6.*

Type: South Victoria Land, Granite Harbor, McMurdo Bay, *British National Antarctic [Discovery] Expedition.*

Thallus well developed, up to 7 cm. in diameter; non-assimilative portion black, carbonaceous, thick, overhanging at the margins, or the smaller parts thinning out, the whole forming a distinct zone 5–7.5 mm. wide, not differentiated into assimilative and non-assimilative portions, inside the black margin white flakes with a few black edges basally, more diffused centrally until often quite scattered, radiately cracked, the areolae irregular and angular; upper cortex 6–7 μ thick, capitate-fastigiate, but appearing as a single layer of dark thick-walled isodiametric cells, the hyphae bearing them thicker-walled but not otherwise differentiated from those of the algal and medullary layers; algal layer variable in thickness, protococcoid, cells small, 4–7 μ; medulla variable in thickness, of loosely woven thin-walled hyphae somewhat vertically arranged; basal layer brownish, about 15 μ, of compact dark brown, more or less isodiametric cells elongating upwards and merging with the medullary hyphae.

Apothecia carbonaceous, somewhat shiny, sessile or subsessile on the white assimilative areolae, flat to convex and almost spherical, up to 0.75 mm. in diameter, with or without a rim, sometimes with an equatorial white cortical remnant [those sectioned measure 120–205 μ tall and 410–650 μ in diameter]; cortex 15–17 μ thick, a palisade of isodiametric cells; medulla of vertical brown hyphae loosely woven and extending to the basal layer; parathecium not differentiated; hypothecium brown, 30–80 μ in the center, tapering to 2–8 μ at the margin and merging with the cortical cells, pseudoparenchymatous, with a tendency to periclinal arrangement; thecium 90–110 μ tall; paraphyses 50–60 × 2 μ, branched or unbranched, septate, when young scarcely expanded, when mature the walls thickened, expanding to a large apical head 4 μ in diameter,

darkened at the surface, tapering slightly below the head; asci short, bluntly clavate, with a well-developed sheath, 8-spored, 36–46 × 14.5–17 μ; ascospores dark, 2-celled, blunt, rarely or only slightly constricted, sometimes undivided, 9–13 × 5–8 μ.

On sericite-orthoclase schist and granodiorite.

MARIE BYRD LAND: Edsel Ford Range, Lichen Peak, *P. Siple & S. Corey 73-11;* Chester Mts., *P. Siple & S. Corey 97A-4.*

BUELLIA **albida** Dodge & Baker, sp. nov. Pl. 60, figs. 365–369.

Type: Marie Byrd Land, Edsel Ford Range, Skua Gull Peak, *P. Siple & S. Corey 72W-11,* growing with *Buellia dendritica.*

Pars non assimilans parva, funiculis tenuibus hypharum nigrarum, reticulata vel irregulariter radians, saxicola; cortex medullaque non evoluta; areolae assimilantes ad 0.67 mm. diametro, irregulares, applanatae vel pustulares, mollissimae madefactae, albidae, sparsae, non continuae; cortex non evolutus, amorphus; algae magnae, sparsae, non abundantes; medulla ad 75 μ crassitudine, laxissime implexa, circum algas bene evoluta; stratum basale ad 20 μ crassitudine, cellulis parvis brunneis compactum.

Apothecia ad 0.35 mm. diametro, subspherica, conica hemisphericave, sessilia, singula, totas areolas tegentia vel annulum cellularum corticalium emortuarum equatorialiter reliquentia, sparsa, singula raro plura in quaque areola, nigra; cortex paucis cellulis brunneis; hypothecium ad 45 μ crassitudine, tenuescens, obscure brunneum reticulatim subtus densius dispositis; thecium 35 μ altitudine; paraphyses 1.5 μ diametro, capitibus obscuris, ad 3 μ diametro, ramosi vel non ramosi, vaginati, epithecium ad 5 μ; asci 37–46(–49) × 13–16 μ, elongati, clavati, vaginati; ascosporae octonae, abnormaliter senae, quaternae vel binae, uniseptatae, subacutae, subconstrictae, brunneae, 11–14 × 5.5–7 μ.

Non-assimilative portion extremely scant, consisting of a few delicate strands of black hyphae, reticulate or irregularly radiating, usually scarcely discernible, covering areas of a few mm. on the rock; no morphological differentiation of cortex and medulla; assimilative areolae up to 0.67 mm. in diameter, irregular in outline, flat to pustular, extremely soft when moistened, whitish, scattered, not continuous; cortex not distinct, almost amorphous; medulla up to 75 μ thick, very loose, best developed around the algae which are large but not abundant, near the outer surfaces; basal layer up to 20 μ thick, of dark small cells compactly arranged.

Apothecia up to 0.35 mm. in diameter, subspherical to conical or hemispherical, sessile upon the areolae, a single one fre-

quently covering the entire areola or leaving only a whitish equatorial zone of dead cortical cells, scattered, usually one per areola, sometimes more, black; parathecium scarcely differentiated, consisting of a few cells merging laterally with the cortex which consists of a few scattered dark cells at the margin; hypothecium up to 45 μ at the center, diminishing laterally to only a few cells at the margin, dark brown, of more or less reticulate cells, denser at the base than just below the thecium; thecium about 35 μ thick; paraphyses 1.5 μ wide, expanding to the darkened heads up to 3 μ in diameter, branched or unbranched, sheath prominent, epithecium about 5 μ, dark; asci 37–46(–49) × 13–16 μ, elongate, clavate, sheath at the apex especially prominent, usually 8-spored, abnormally with 6, 4, or 2 spores, the spores correspondingly larger; ascospores 11–14 × 5.5–7 μ, 2-celled, ends slightly pointed, slightly constricted at the septum, dark.

Growing with *Buellia dendritica* on sericite-orthoclase schist and on sandy loam.

MARIE BYRD LAND: Edsel Ford Range, Skua Gull Peak, *P. Siple & S. Corey 72W-10, 72W-11*, type; Mt. Stancliff, *P. Siple & S. Corey 72A-1;* Lichen Peak, *P. Siple & S. Corey 73-1.*

RINODINA

RINODINA S. F. Gray, Nat. Arr. Brit. Pl. 1: 448. 1821. (pr. p. min.); Massalongo, Ricerche Auton. Lich. 14. 1852.

Lecanora subg. *Rinodina* Ach., Syn. Lich. 146. 1814.

Dimelaena Norm., Nyt Mag. Naturvidensk. 7: 231. 1853 (pr. p. min.).

Berengeria Trevisan, Riv. Period. Lav. Accad. Padova, 265. 1851-2.

Pleorinis Clements, Gen. Fung. 84. 1909.

Merorinis Clements, Gen. Fung. 84. 1909.

Dictyorinis Clements, Gen. Fung. 84. 1909.

The type species was not designated. Of Gray's species all but three, *R. exigua, R. periclea,* and *R. sophodes,* have been transferred elsewhere. Acharius had included *R. periclea* and *R. sophodes* in his subgenus. When Massalongo gave the genus its present definition, he described two new species and

included *R. oreina* and *R. sophodes* from Archarius' subgenus. Since *R. oreina* is the type of *Beltraminia,* and since *R. sophodes* is the only species common to all three treatments, the latter may be taken as the type. Thus it will conserve the name in the sense it has been almost universally used since it was redefined by Massalongo. *Dimelaena* Norm. was based on six species now included in *Physcia* and on four species in *Rinodina.* As it is antedated by either genus, a consideration of its type species is relatively unimportant. *Berengeria* was proposed shortly after *Rinodina* was redefined by Massalongo, and contains all the species proposed by Massalongo, including his new ones, with some others. It was early abandoned as a synonym of *Rinodina. Pleorinis* was based on *R. polyspora* Th. Fr. *Merorinis* was based on *R. Conradi* Koerb. and is available if the subsection *Conradia* is raised to generic rank. *Dictyorinis* was based on *R. diplinthia* Nyl. for the species of *R. Eurinodina* subsect. *Conradia* with muriform spores.

Thallus crustose, rarely squamulose, uniform or with an effigurate margin (in *Beltraminia),* attached to the substrate by hyphae of the prothallus or of the medulla, without rhizinae; ecorticate, or with a fastigiate cortex, or in the higher forms with a palisade of pseudoparenchyma; algae protococcoid; medulla of loosely woven thin-walled hyphae. Apothecia circular, immersed or sessile, lecanorine, but in some species with the algae early disappearing from the amphithecium; parathecium thin or absent; epithecium dark or black, horny or pulverulent, usually colored purple or violet with KOH; hypothecium hyaline, rarely dark; paraphyses filiform, seldom forked, more or less gelified, usually capitate; asci normally 8-spored, exceptionally up to 24 spores; spores smoke gray, brown, or black, 2–4-celled, wall very thick, commonly united by an isthmus. Spermogonia immersed or in warts, irregularly flask-shaped; spermatia small, elongate, straight.

Malme (Bih. K. Svensk. Vetensk. Akad. Handl. III. **28**[1]: 7–15. 1902) divided the genus into four sections and subdivided the section *Eurinodina* into two subsections (for characters see p. 631). Vainio (Ark. f. Bot. **8**[4]: 76–82. 1909) proposed

Melanaspicilia for species with immersed apothecia which Zahlbruckner has placed in *Eurinodina.* This entity seems worthy of recognition as another section at least. Several of the other sections have also been described as genera. A monograph of the genus is badly needed. Two species from the Antarctic Archipelago belong in *Beltraminia,* three in *Melanaspicilia,* and two besides our two from Marie Byrd Land and King Edward VII Land belong to *Eurinodina,* subsect. *Pachysporaria.*

KEY TO ANTARCTIC SPECIES

Thallus effigurate; spore walls thin, not polaribilocular.............. BELTRAMINIA
  Spores 18–20 × 8–10 μ; apothecia 0.25 mm.; thallus 3 mm. thick...... *R. crassa*
  Spores 14–17 × 6.5–9 μ; apothecia 0.5–1.3 mm.; thallus 0.5–0.6 mm......... .... *R. Petermanni*
Thallus uniform; spores 2-celled.
  Apothecia immersed; hypothecium fuscous.................. MELANASPICILIA
    Parathecium not developed; thallus KOH–.................. *R. hypopoichila*
    Parathecium hyaline.
      Cortex 15–20 μ, KOH yellow, rarely reddening in the center.... *R. ditissima*
      Cortex 20–40 μ, KOH red.................................. *R. erythrodia*
  Apothecia sessile......................... EURINODINA subsect. PACHYSPORARIA
    Spores 11–13.5 × 6–8 μ; apothecia 1.35 mm.................... *R. sordida*
    Spores 20–28 × 8–13 μ.
      Cortex 30–40 μ; apothecia 1.20 μ; paraphyses 1 μ in diameter.......... .... *R. olivaceobrunnea*
      Cortex 10 μ; apothecia 0.2–0.6 μ; paraphyses 3 μ............ *R. egentissima*
    Spores 28–34 × 12–14 μ.................................. *R. turfacea*

RINODINA **sordida** Dodge & Baker, sp. nov.

Pl. 61, figs. 387–392.

Type: Marie Byrd Land, Edsel Ford Range, Skua Gull Peak, *P. Siple & S. Corey 72W-6.*

Thallus ad 3 cm. diametro; pars non assimilans parva, nigra; cortex capitato-fastigiatus, cellulis brunneis pachydermaticis; medulla non bene evoluta, cellulis hyalinis vel pallide brunneis; stratum basale cortici simile; areolae assimilantes ad 1 mm. diametro, angulares, diffractae, continuae, albae vel sordide griseae, marginibus nigris; cortex fastigiatus, lateribus bene evolutus, saepe cum strato conspicuo cellularum emortuarum tectus; stratum gonidiale non bene evolutum, algis in dimidio superiore sparsis; algae ad 18 μ diametro, protococcoideae; medulla hyphis laxe contexta; stratum basale cellularum parvarum obscurarum.

Apothecia ad 1.35 mm. diametro, angularia, sinuosa vel hemispherica, convexa, applanata, marginata vel concava, superficie nonnumquam diffracta, sparsa vel conferta, in areolis sessilia; amphithecium 100 μ crassitudine; cortex 20 μ, cellulis

sphericis subhyalinis; stratum gonidiale cellulis 4–5 μ diametro, sparsis; medulla deest; hypothecium ad 230 μ crassitudine, ad marginem tenuescens, hyalinum, cellulis minutis compactum; parathecium deest; thecium ad 70 μ altum; paraphyses 1 μ, apicibus 2–5 μ diametro, ramosi sub apicibus vel non ramosi, septati, pachydermatici; asci 47–54–63 × 16–19 μ, clavati, vaginati, maturitate breviores; sporae octonae, 11–13.5 × 6–8 μ, uniseptatae, subconstrictae, obtusae acutaeve, brunneae.

Thallus up to 3 cm. in diameter; non-assimilative portion scant, black, dull; cortex capitate-fastigiate, cells brown and thick-walled; medulla not differentiated morphologically, cells hyaline to pale brown; basal layer similar to the cortex; assimilative areolae up to 1 mm. in diameter, angular by deep cracks, continuous, white to dark gray, the margins frequently blackened; cortex fastigiate, well developed laterally and in places over the upper surface, often with a conspicuous zone of dead cortical cells; algal layer not well differentiated, cells scattered in the upper half of the thallus; algae up to 18 μ in diameter, protococcoid; medulla of loosely woven hyphae; basal layer of dark, small, closely united cells merging laterally with the fastigiate cortex.

Apothecia up to 1.35 mm. in diameter, angular, sinuous or hemispherical, convex, flattened with a faint margin or umbilicate, surface cracked, scattered or closely gregarious, sessile on the areolae; amphithecium 100 μ thick; cortex 20 μ thick, of spherical subhyaline cells; gonidial layer of scattered cells 4–5 μ in diameter; no medulla or parathecium; hypothecium up to 230 μ thick, thinning toward the margin, hyaline, compact, of small cells; thecium up to 70 μ thick; paraphyses 1 μ expanding to apices 2–5 μ, branched or unbranched, conspicuously septate, thick-walled, the outer surfaces of the heads with a prominent dark cap, often much branched near the top forming short clusters of branches each a few cells long; asci 8-spored, 47–54–63 × 16–19 μ, slender, clavate with a well developed gelified sheath, the mature asci shorter and stouter as the spores fill the sac; ascospores 11–13.5 × 6–8 μ, 2-celled, slightly constricted at the septum, blunt or pointed, dark brown.

On orthoclase-sericite-siderite schist.

Marie Byrd Land: Edsel Ford Range, Skua Gull Peak, *P. Siple & S. Corey 72W-6*, type, *72W-13*.

RINODINA **olivaceobrunnea** Dodge & Baker, sp. nov.
Pl. 61, figs. 381–386.

Type: Marie Byrd Land, Edsel Ford Range, Skua Gull Peak, *P. Siple & S. Corey 72W-13.*

Thallus olivaceo-brunneus, gelifactus, mollis; cortex 30–40 μ, pseudoparenchymaticus, paullo obscurus, cum strato cellularum corticalium emortuarum tectus; medulla hyphis reticulatim implexis; stratum basale cortici simile, nonnumquam obscurius, raro attenuatum, in funiculis subrhizoideis.

Apothecia ad 1.20 mm. diametro, irregularia, angularia vel circularia, applanata, marginibus crenulatis, disco nigro, excipulo pallide olivaceo, subsessilia; cortex continuus cum ei thalli; stratum gonidiale 55–60 μ crassitudine, ad 40 μ sub hypothecio tenuescens, cellulis 10–12 μ, sine vaginis; parathecium 20–25 μ crassitudine, hyalinum, continuum cum hypothecio, non cum cortice mergens; hypothecium 20–30 μ crassitudine, hyalinum, pseudoparenchymaticum; thecium 100–120 μ altitudine; paraphyses 1 μ diametro, capitibus pallide brunneis, 2–3 μ, ramosi, vagina non prominente, epithecium circa 10 μ crassitudine, pallide brunneum, gelifactum; asci 70–92 × 16–28 μ, elongato-clavati, apicibus vaginatis; ascosporae octonae, 22–28 × 10–13 μ, uniseptatae, raro polaribiloculares septoque constrictae, obscure brunneae.

Assimilative portion of thallus spreading among loose gravel and mosses, not conspicuous, olive brown to black, rather gelified, soft; cortex 30–40 μ, fastigiate, pseudoparenchymatous, outer cells slightly darkened, frequently with a thick layer of dead cortical cells covering the outside; medulla of loosely and reticulately woven hyphae; basal layer similar to the cortex, occasionally darker or attenuated into almost rhizoidal strands of attachment.

Apothecia up to 1.20 mm. in diameter, irregular in shape, angular to circular, flattened, with a distinct, often somewhat crenulate margin, disc black with a white to pale olive exciple, subsessile; cortex continuous with that of the thallus and of the same structure; algal layer protococcoid, 55–60 μ, thinning to 40 μ under the hypothecium, cells 10–12 μ, without the thick sheaths; parathecium 20–25 μ thick, continuous from the hypothecium, not merging with the cortex; hypothecium 20–30 μ thick, dark, pseudoparenchymatous; thecium 100–120 μ tall; paraphyses 1 μ in diameter expanding to pale brown heads 2–3 μ in diameter, mostly branched, the outer surfaces of the heads with a narrow darkened rim, sheath not prominent, epithecium about 10 μ thick, pale brown, gelified; asci 70–92 ×

16–28 μ, 8-spored, broadening at maturity but elongate-clavate when young with a very prominent gelified sheath at the tips; ascospores 22–28 × 10–13 μ, 2-celled, sometimes connected by a canal, rarely constricted at the septum, dark brown.

Growing over mosses and gravel from coarse-grained pink granite.

In the younger areolae, the upper cortex consists of 3–6 layers of isodiametric cells.

KING EDWARD VII LAND: Rockefeller Mts., Mt. Helen Washington, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff HW-2, HW-6, HW-9, HW-12, HW-13, HW-18.*

MARIE BYRD LAND: Edsel Ford Range, Mt. Rea-Cooper, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff R-2, R-4;* Skua Gull Peak, *P. Siple & S. Corey 72W-13,* type.

PHYSCIACEAE

Thallus foliose, repeatedly lobed, more rarely subfruticose, usually attached to the substrate by rhizinae, heteromerous, dorsiventral or radiate; corticate; with *Protococcus* algae. Apothecia circular, sessile, lecideine or lecanorine; paraphyses simple; asci 8-spored; ascospores brown, 2-celled, rarely 4-celled, or by the formation of a few vertical septa, few-celled muriform with a thickened spore wall. Spermatia short, straight.

Only sterile specimens referred to *Physcia* have been found in the Antarctic.

PHYSCIA

PHYSCIA (Schreber) Hampe ap. Furnrohr, Naturh. Topogr. Regensburg **2**: 249. 1839.

Lichen subgen. *Physcia* Schreber in Linné, Gen. Pl. ed. 8. 768. 1791.

The nomenclatorial history of *Physcia* and the correct application of the name is difficult to trace as we have not had access to all the pertinent literature. In the first half of the nineteenth century the name was applied to various groups of Parmeliaceae, Teloschistaceae, and Physciaceae. From the synonymy listed in Zahlbruckner, Cat. Lich. Univ. **7**: 577–704. 1931, apparently the first combination of a species in the genus as now recognized was *P. hispida* (Hoffm.) Frege, Deutsch. Bot. Taschenbuch **2**: 169. 1812. Hampe (ap. Furnrohr, Naturh.

Topogr. Regensburg 2: 249–250. 1839) added four species at present recognized in this genus. By 1860 Nylander and Th. M. Fries described the genus in its present sense except for more recent segregates. From such data as are available, the type species appears to be *P. pulverulenta* (Schreber) Hampe, the only species of this genus described by Schreber, or *P. hispida* (Hoffm.) Frege. Either of these species would conserve the name in the sense current among modern lichenologists.

Thallus foliose, appressed or ascending, usually attached to the substrate by rhizinae, repeatedly lobed, laciniae mostly slender; upper cortex a palisade of hyphae forming a pseudoparenchyma; lower cortex of periclinal hyphae not greatly differentiated from the medulla (fastigiate in *P. fuscella* from Antarctica); algae *Protococcus;* medulla arachnoid, of thin-walled periclinal hyphae; apothecia circular, sessile, lecanorine, disc brown to black, nude or pruinose; paraphyses simple, usually septate; epithecium not colored by KOH; hypothecium hyaline or dark; asci 8-spored; ascospores brown, elongate to ellipsoidal, usually 2-celled, rarely 4-celled or few-celled muriform, wall thickened; spermogonia immersed or slightly protruding; spermatia elongate to long-cylindric, straight, or in a few species filiform and curved.

The sections are separated as follows:

Hypothecium black; spores 2-celled; tropical and subtropical........... DIRINARIA
Hypothecium hyaline.
  Spores 2-celled .... EUPHYSCIA
  Spores few-celled muriform; New Zealand..................... HYPERPHYSCIA

For key to Antarctic species see p. 584.

LICHEN PARASITES

Besides the possible parasites described on p. 525 as *Thelidium Caloplacae* and *T. parvum,* the following species has been found on *Parmelia.*

DIPLONAEVIA **Parmeliae** Dodge & Baker, sp. nov.

Pl. 62, figs. 396–400.

Type: Marie Byrd Land, Edsel Ford Range, Skua Gull Peak, *P. Siple & S. Corey 72W-3.*

Apothecia ad 150 μ diametro, fusca nigrave, convexa, emarginata; parathecium 10–15 μ crassitudine, pseudoparenchymaticum, obscurum; hypothecium 20 μ crassitudine, brunneum, hyphis dense irregulariter intertextis; medulla dilutior, cellulis brevibus irregularibus, 2 × 4 μ; thecium 30–35 μ altitudine; paraphyses 1 × 1.5 μ, recti, septati, apicibus expansis obscuris ramosis, epithecium 10–15 μ, obscurum, rugosum; asci 21–24 × 8–10 μ, breviter clavati, vagina tenui; ascosporae 7–8 × 2–2.5 μ, octonae, hyalinae, vaginatae.

Apothecia up to 150 μ in diameter, fuscous to black, convex, emarginate; parathecium 10–15 μ thick, pseudoparenchymatous, dark; hypothecium about 20 μ thick, brownish, of irregularly and densely interwoven hyphae; medulla of the same texture, lighter, of short irregular cells 2 × 4 μ, ending irregularly in the host tissue; thecium 30–35 μ tall; paraphyses 1–1.5 μ, straight, septate, the tips slightly enlarged, darkened, possibly branched; epithecium 10–15 μ thick, dark, rugose, continuous with the parathecium; asci 21–24 × 8–10 μ, short-clavate with a thin sheath, 8-spored, ascospores 7–8 × 2–2.5 μ, apparently 2-celled, one end slightly pointed, the other more blunt, hyaline with a faint halo.

Parasitic on *Parmelia variolosa* Dodge & Baker.

MARIE BYRD LAND: Edsel Ford Range, Skua Gull Peak, *P. Siple & S. Corey 72W-3.*

Explanation of Plate

PLATE 38

All figures except the habit sketches were drawn with the aid of an Abbé camera lucida. Magnifications are given for each figure.

Figs. 1–5. *Thelidium inaequale.*

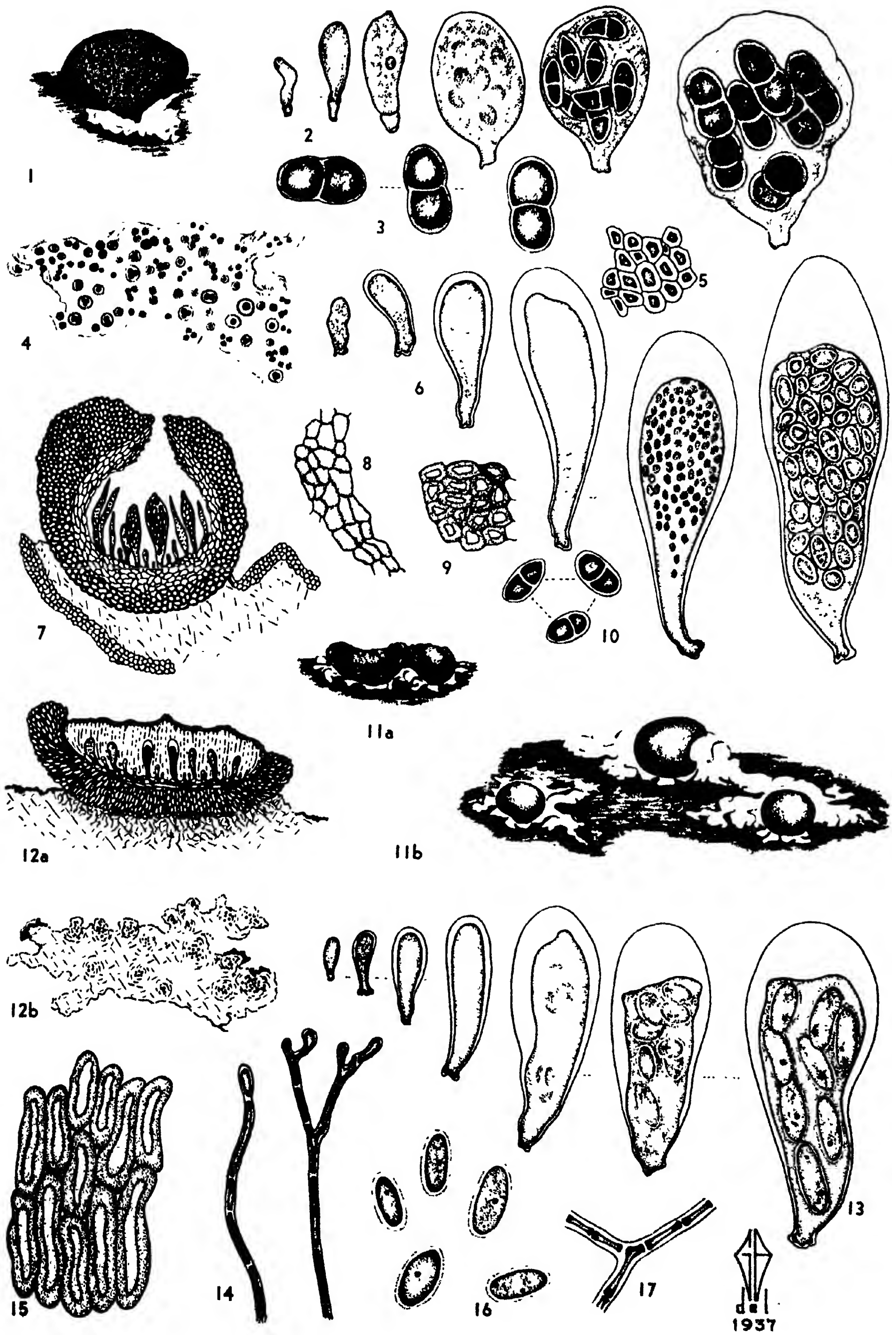
Fig. 1. Habit sketch of perithecium and thallus. × 104.
Fig. 2. Development of ascus through maturity. × 1100.
Fig. 3. Mature spores. × 1100.
Fig. 4. Detail of gelatinous, non-cellular thallus. × 434.
Fig. 5. External view of the apothecial wall cells. × 434.

Figs. 6–10. *Thelidium Caloplacae.*

Fig. 6. Development of ascus through maturity. × 1100.
Fig. 7. Section of perithecium and host. × 218.
Fig. 8. Detail of cells from inner wall of perithecium. × 1100.
Fig. 9. Detail of cells from outer wall layers of the perithecium. × 1100.
Fig. 10. Mature spores. × 1100.

Figs. 11–17. *Lecidea capsulata.*

Fig. 11a. Habit sketch, apothecia with marginal rims; from Mt. Rea. × 65.
Fig. 11b. Habit sketch, apothecia without marginal rims; from Mt. Donald Woodward. × 65.
Fig. 12a. Section through apothecium. × 1100.
Fig. 12b. Section through thallus. × 1100.
Fig. 13. Development of ascus through maturity. × 1100.
Fig. 14. Paraphyses. × 1100.
Fig. 15. Detail of cells from the hypothecium. × 1100.
Fig. 16. Mature spores from various collections showing variation in size and shape. × 1100.
Fig. 17. Hyphae from the thallus medulla. × 1100.



SECOND BYRD ANTARCTIC EXPEDITION

Explanation of Plate

PLATE 39

Figs. 18–21. *Lecidea Wadei.*

Fig. 18. Section through apothecium and thallus, showing amorphous basal region with clumps of bacteria. × 104.

Fig. 19. Development of ascus through maturity. × 1100.

Fig. 20. Paraphysis. × 1100.

Fig. 21. Mature spores. × 1100.

Figs. 22–28. *Lecidea Siplei.*

Fig. 22. Habit sketch of thallus and apothecia. × 20.

Fig. 23. Paraphyses. × 1100.

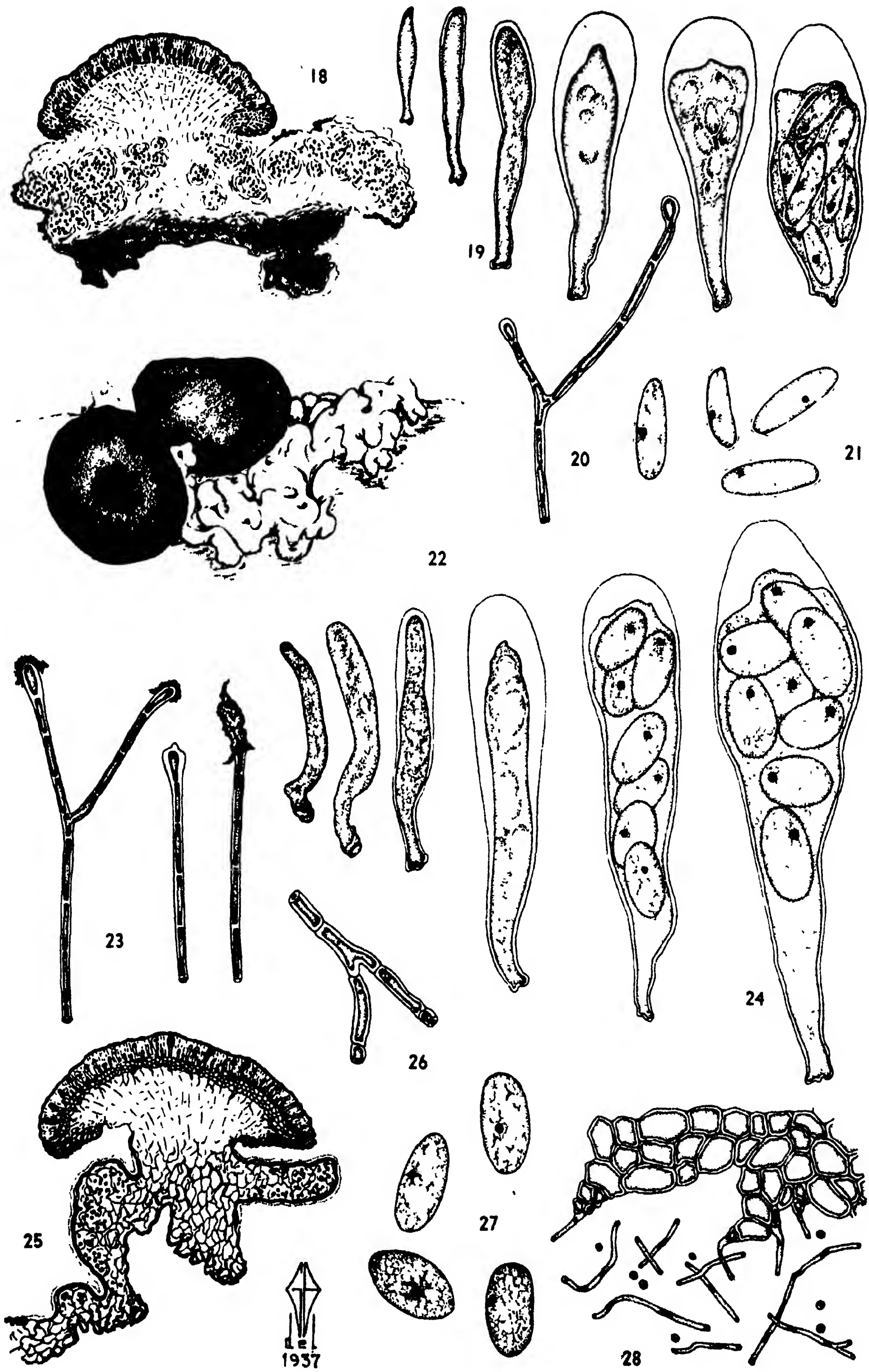
Fig. 24. Development of ascus through maturity. × 1100.

Fig. 25. Section through apothecium and thallus. × 35.

Fig. 26. Hyphae from the reticulate medulla of the thallus. × 1100.

Fig. 27. Mature spores. × 1100.

Fig. 28. Detail of cells from the hypothecium and adjoining filamentous medulla. × 1100.



SECOND BYRD ANTARCTIC EXPEDITION

EXPLANATION OF PLATE

PLATE 40

Figs. 29–34. *Lecidea Coreyi.*

Fig. 29. Section through apothecium and thallus. × 55.

Fig. 30. Detail of hypothecial cells and adjacent medulla with thinner-walled cells. × 1100.

Fig. 31. Paraphyses. × 1100.

Fig. 32. Development of ascus through maturity. × 1100.

Fig. 33. Mature spores. × 1100.

Fig. 34. Detail of medullar hyphae. × 1100.

Figs. 35–38. *Lecidea ecorticata.*

Fig. 35. Section through apothecium and thallus. × 55.

Fig. 36. Paraphyses. × 1100.

Fig. 37. Development of ascus through maturity. × 1100.

Fig. 38. Spores, showing variation in size and shape. × 1100.

Figs. 39–41. *Lecidea Byrdii.*

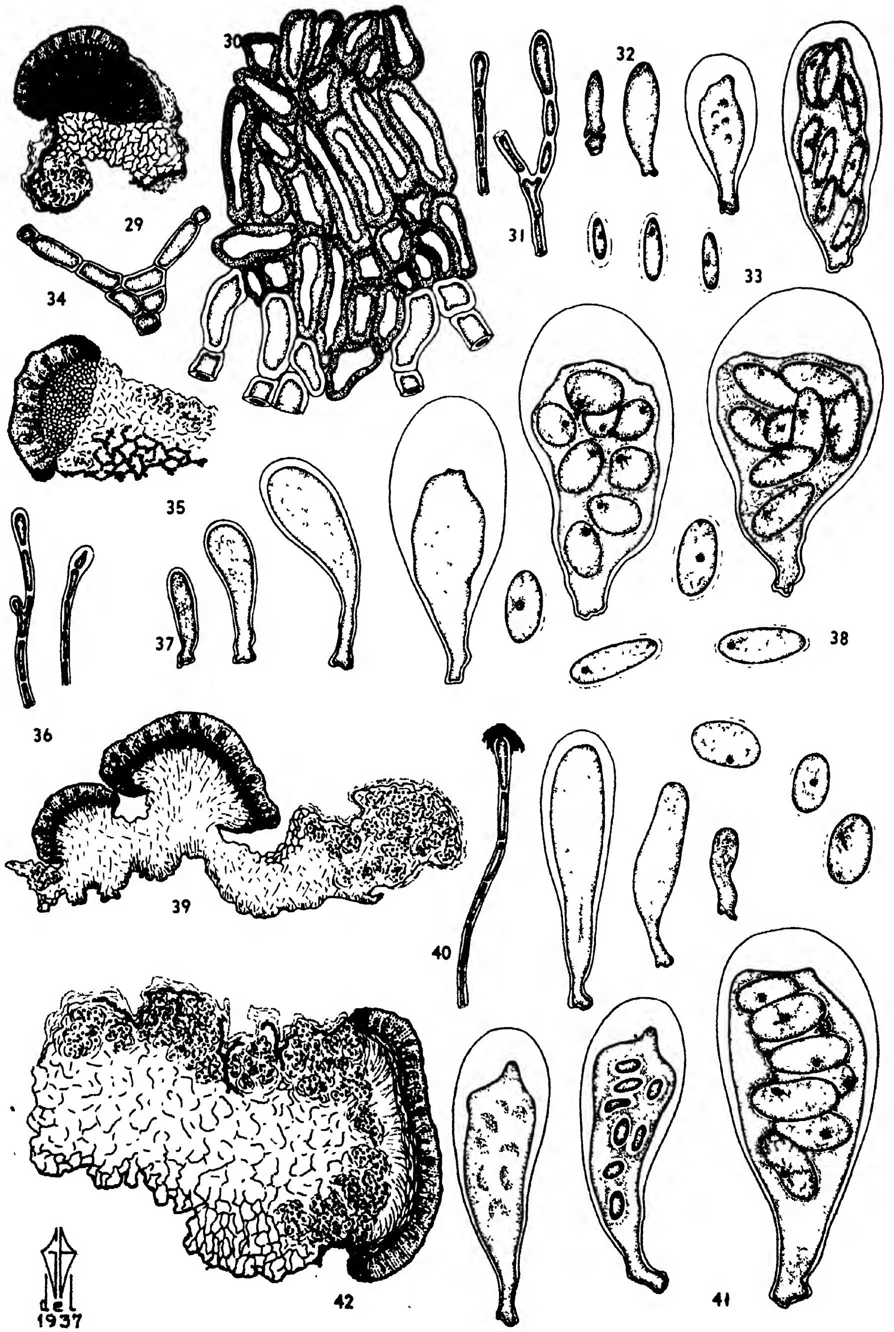
Fig. 39. Section through apothecium and thallus. × 55.

Fig. 40. Paraphysis, the head unusually expanded. × 1100.

Fig. 41. Development of ascus through maturity. × 1100.

Fig. 41a. Mature spores. × 1100.

Fig. 42. *Lecidea Stancliffi.* Section through apothecium and thallus. × 55.

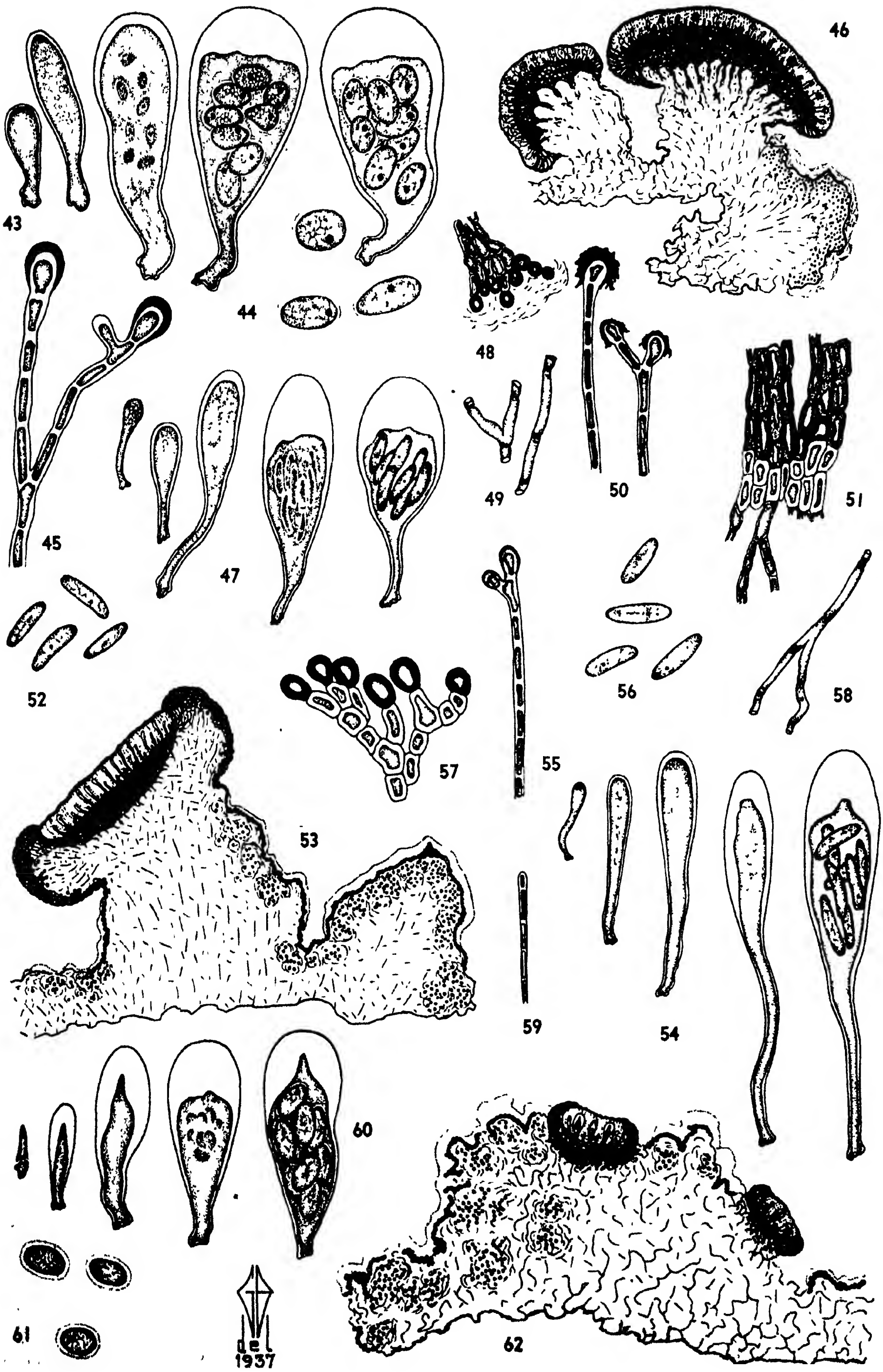


SECOND BYRD ANTARCTIC EXPEDITION

Explanation of Plate

PLATE 41

Figs. 43–45. *Lecidea Stancliffi.*
Fig. 43. Development of ascus through maturity. × 1100.
Fig. 44. Mature spores. × 1100.
Fig. 45. Paraphysis. × 1100.
Figs. 46–52. *Lecidea cancriformis.*
Fig. 46. Section through apothecia and thallus. × 35.
Fig. 47. Development of ascus through maturity. × 1100.
Fig. 48. Detail of cortex of the thallus. × 1100.
Fig. 49. Medullar hyphae from the thallus. × 1100.
Fig. 50. Paraphyses. × 1100.
Fig. 51. Detail of hypothecium. × 1100.
Fig. 52. Mature spores. × 1100.
Figs. 53–56. *Lecidea Blackburni.*
Fig. 53. Section of apothecium and thallus. × 55.
Fig. 54. Development of ascus through maturity. × 1100.
Fig. 55. Paraphysis. × 1100.
Fig. 56. Mature spores. × 1100.
Figs. 57–62. *Lecidea Painei.*
Fig. 57. Detail of cortex and subcortical thalline tissues. × 1100.
Fig. 58. Detail of medullar hyphae. × 1100.
Fig. 59. Paraphysis. × 1100.
Fig. 60. Development of ascus through maturity. × 1100.
Fig. 61. Mature spores. × 1100.
Fig. 62. Section through thallus and apothecia. × 55.



SECOND BYRD ANTARCTIC EXPEDITION

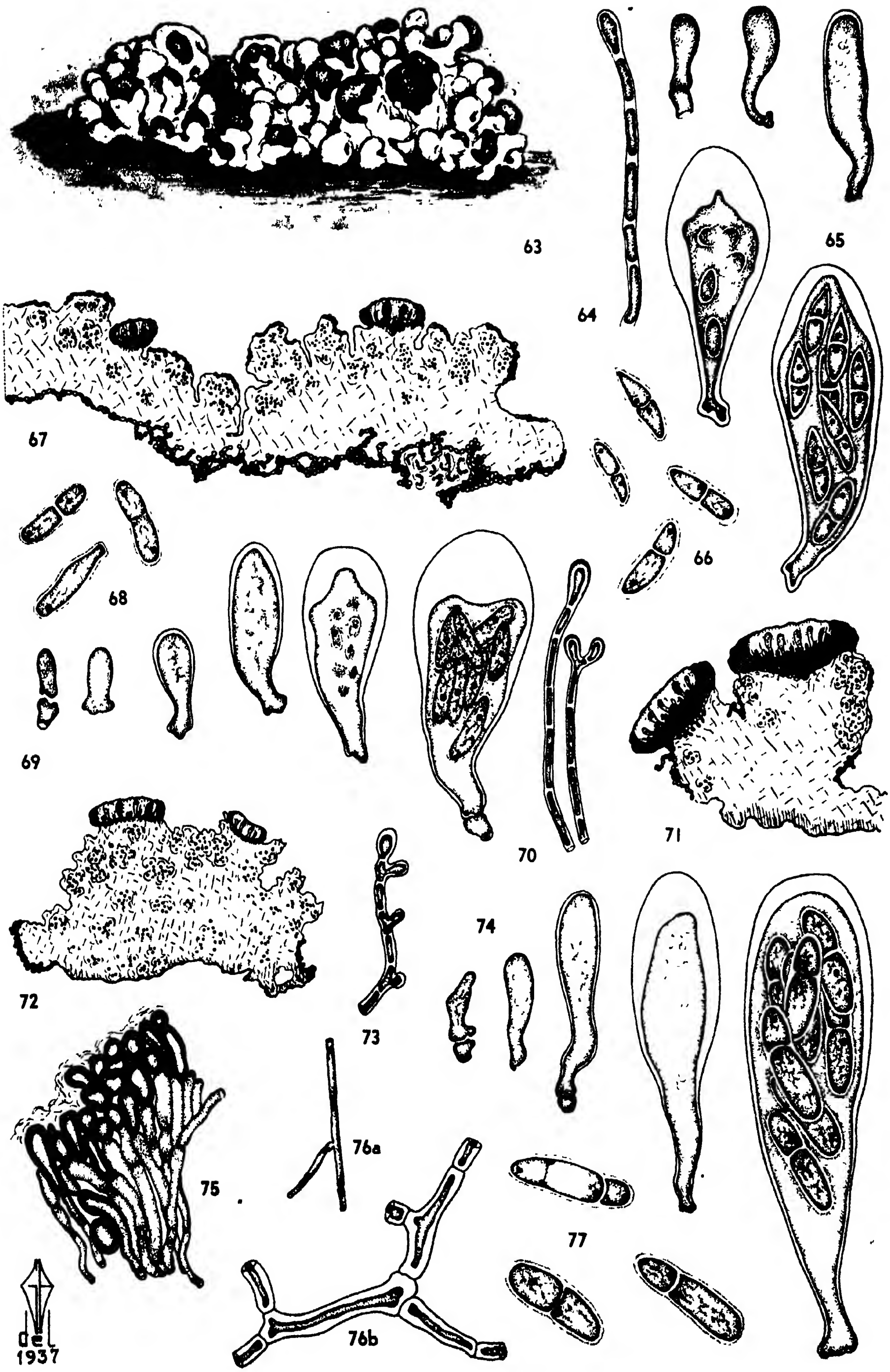
EXPLANATION OF PLATE

PLATE 42

Figs. 63–67. *Catillaria floccosa.*
Fig. 63. Habit sketch showing thallus and apothecia. × 24.
Fig. 64. Paraphysis. × 1100.
Fig. 65. Development of ascus through maturity. × 1100.
Fig. 66. Mature spores. × 1100.
Fig. 67. Section through apothecia and thallus. × 55.

Figs. 68–71. *Catillaria cremea.*
Fig. 68. Mature spores. × 1100.
Fig. 69. Development of ascus through maturity. × 1100.
Fig. 70. Section of apothecia and thallus. × 55.
Fig. 71. Paraphyses. × 1100.

Figs. 72–77. *Catillaria arachnoidea.*
Fig. 72. Section of apothecia and thallus. × 55.
Fig. 73. Paraphysis. × 1100.
Fig. 74. Development of ascus through maturity. × 1100.
Fig. 75. Detail of parathecium. × 1100.
Fig. 76a. Detail of hyphae from sub-apothecial region. × 1100.
Fig. 76b. Detail of hyphae from the medulla proper. × 1100.
Fig. 77. Mature spores. × 1100.



SECOND BYRD ANTARCTIC EXPEDITION

EXPLANATION OF PLATE

PLATE 43

Figs. 78–83. *Catillaria granulosa.*

Fig. 78. Section through apothecium and thallus. × 104.

Fig. 79. Development of ascus through maturity. × 1100.

Fig. 80. Spores in varying degrees of maturity. × 1100.

Fig. 81. Detail of cells from the region adjacent to the thecium. × 1100.

Fig. 82. Paraphysis. × 1100.

Fig. 83. Medullar hypha. × 1100.

Figs. 84–87. *Catillaria inconspicua.*

Fig. 84. Development of ascus through maturity. × 1100.

Fig. 85. Paraphyses. × 1100.

Fig. 86. Section through apothecium and thallus. × 55.

Fig. 87. Spores in varying degrees of maturity. × 1100.

Figs. 88–93. *Rhizocarpon flavum.*

Fig. 88. Spores from different sources and showing variation in size and shape. × 1100.

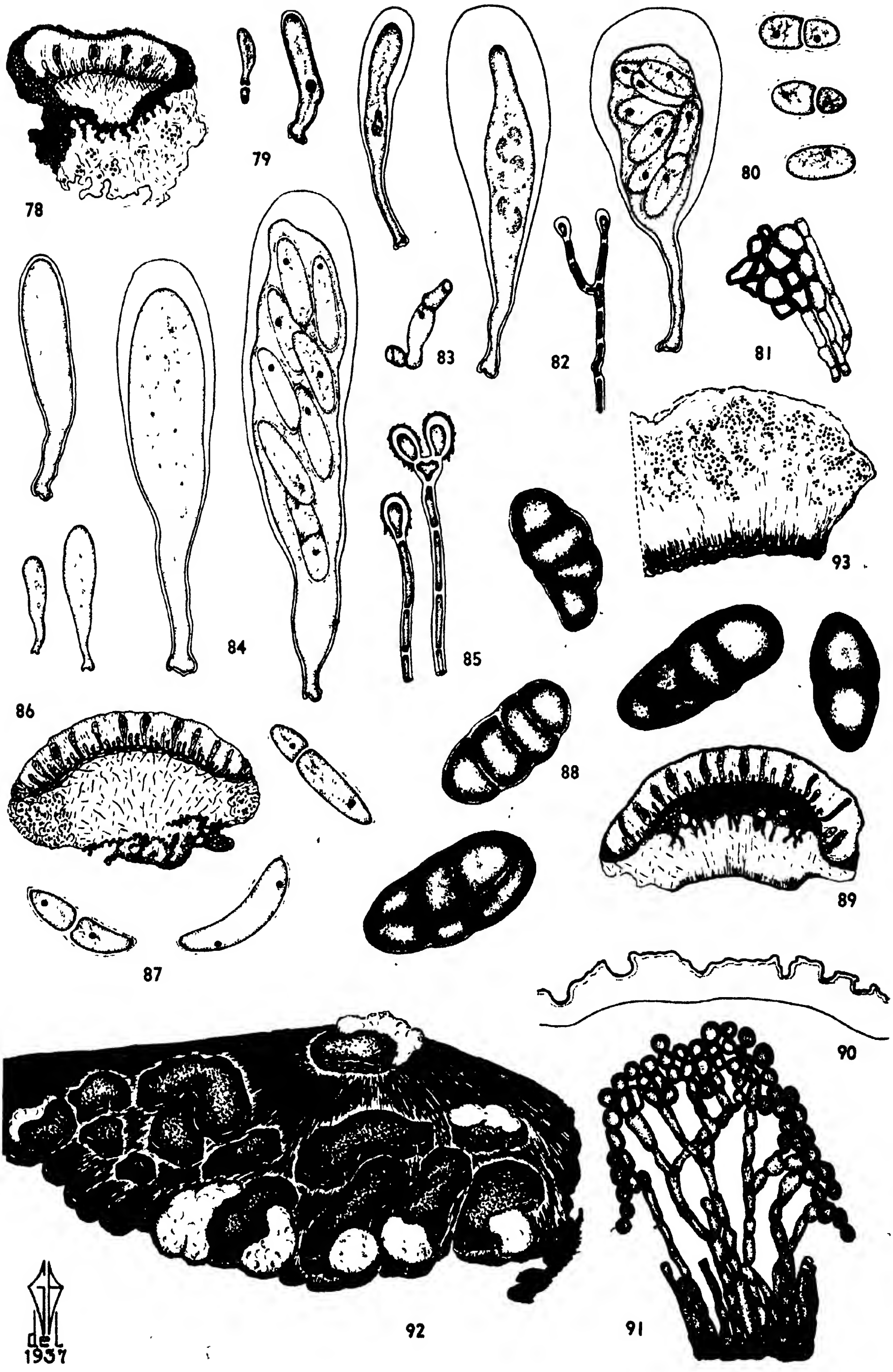
Fig. 89. Section through an apothecium. × 35.

Fig. 90. Section through non-assimilative areola. × 104.

Fig. 91. Detail of non-assimilative areola from base to upper surface. × 434.

Fig. 92. Habit sketch showing non-assimilative areas, assimilative areolae, and apothecia. × 17.

Fig. 93. Section through an assimilative areola. × 35.



SECOND BYRD ANTARCTIC EXPEDITION

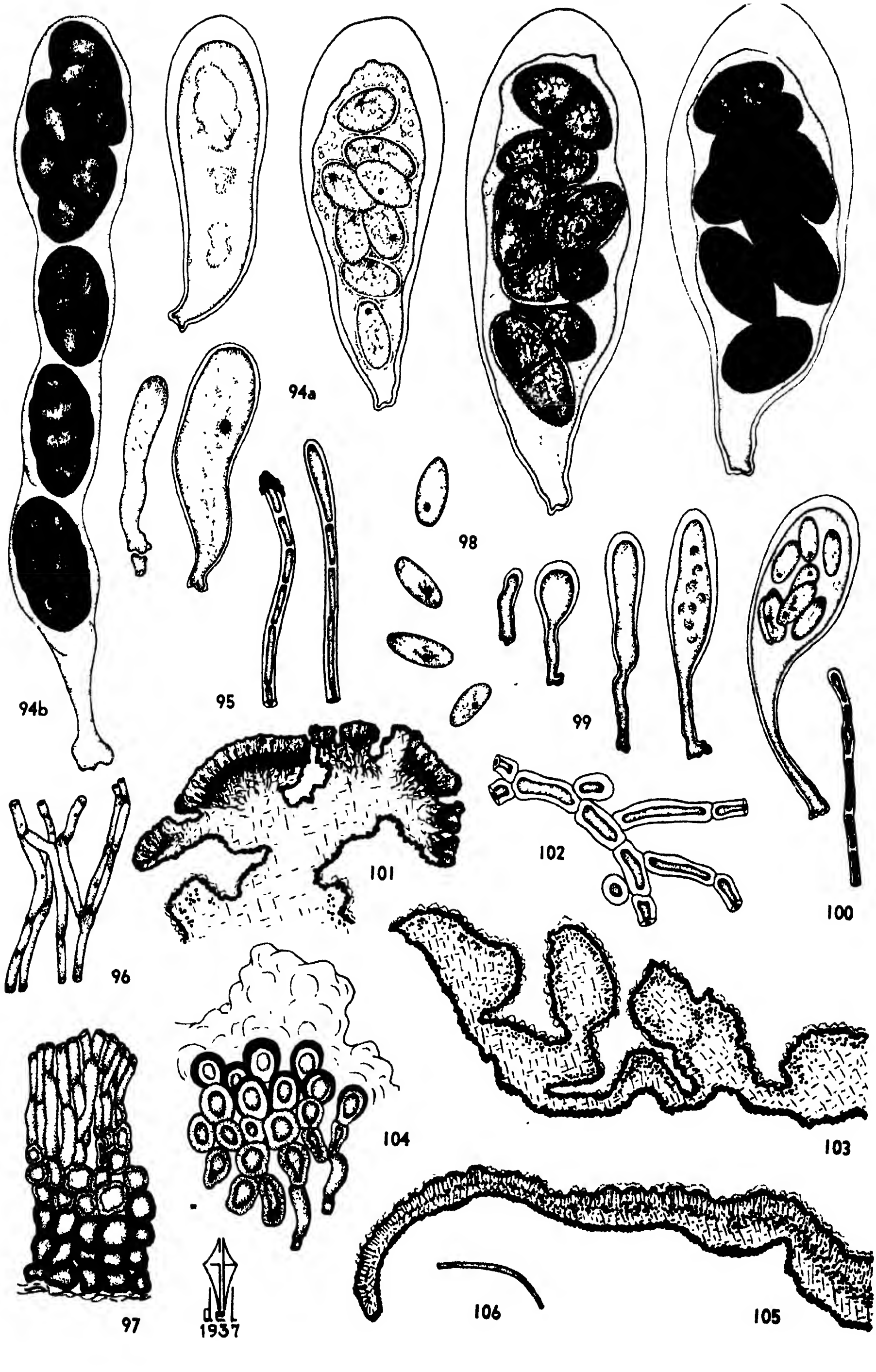
Explanation of Plate

PLATE 44

Figs. 94–97. *Rhizocarpon flavum.*
- Fig. 94a. Development of ascus through maturity. × 1100.
- Fig. 94b. Extremely attenuated ascus. × 1100.
- Fig. 95. Paraphyses. × 1100.
- Fig. 96. Detail of medullar hyphae from assimilative areola. × 1100.
- Fig. 97. Detail of basal cortex from assimilative areola. × 1100.

Figs. 98–104. *Umbilicaria rugosa.*
- Fig. 98. Mature spores. × 1100.
- Fig. 99. Development of ascus through maturity. × 1100.
- Fig. 100. Paraphysis. × 1100.
- Fig. 101. Section through apothecium. × 35.
- Fig. 102. Detail of medullar hyphae. × 1100.
- Fig. 103. Section through thallus. × 35.
- Fig. 104. Detail of upper cortex showing extensive decortication. × 1100.

Figs. 105–106. *Umbilicaria pateriformis.*
- Fig. 105. Section through thallus. × 55.
- Fig. 106. Detail of medullar hypha. × 1100.



SECOND BYRD ANTARCTIC EXPEDITION

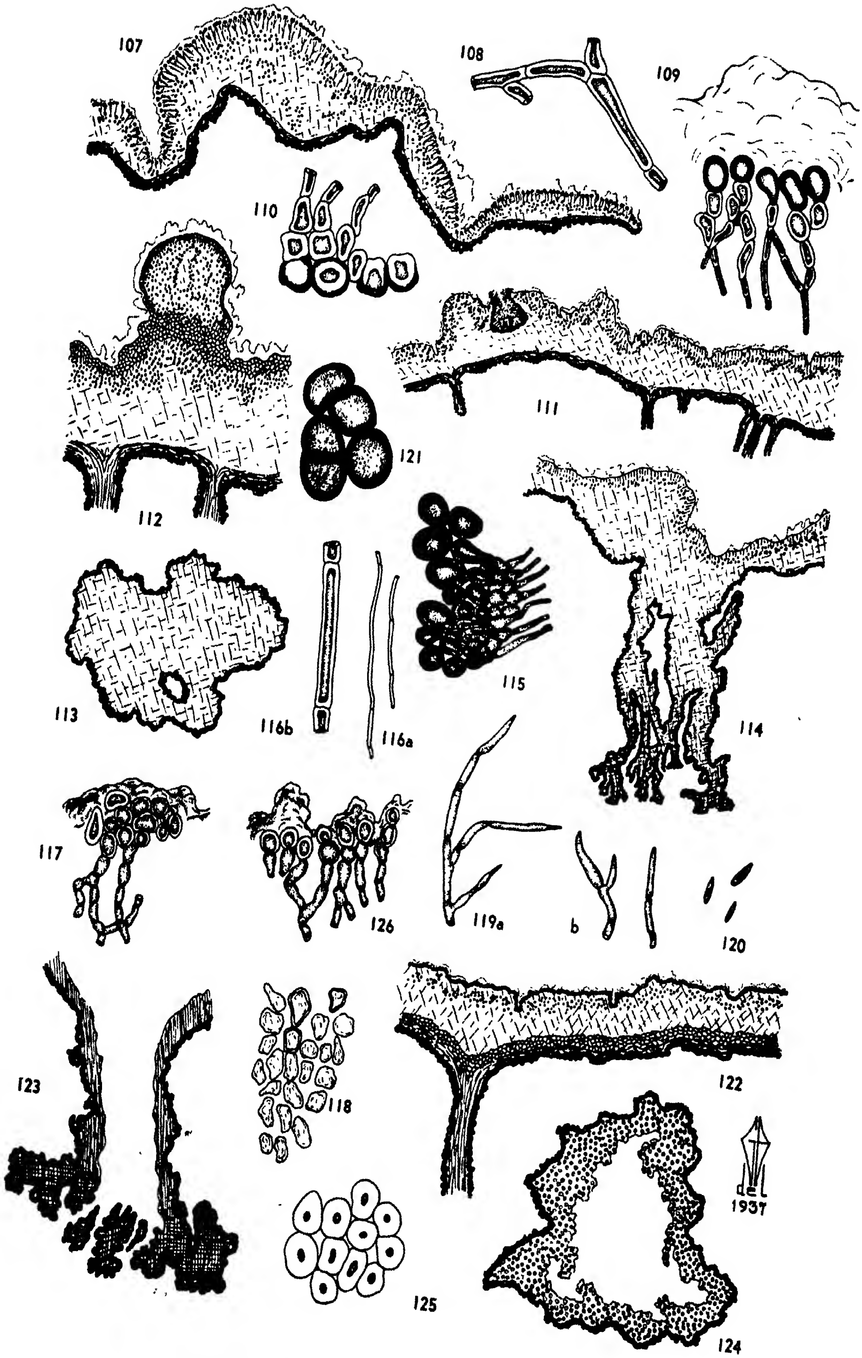
Explanation of Plate

PLATE 45

Figs. 107–110. *Umbilicaria cerebriformis.*
- Fig. 107. Section through thallus. × 35.
- Fig. 108. Detail of medullar hyphae. × 1100.
- Fig. 109. Detail of upper cortex with decorticating zone. × 1100.
- Fig. 110. Detail of basal cortex. × 1100.

Figs. 111–121. *Umbilicaria spongiosa.*
- Fig. 111. Section of thallus with spermagonium. × 18.
- Fig. 112. Section through an isidium. × 55.
- Fig. 113. Cross-section of central thallus attachment. × 18.
- Fig. 114. Longitudinal-section of thallus attachment. × 18.
- Fig. 115. Detail of cortex from rhizoid margin. × 1100.
- Fig. 116a. Fibrous hyphae from rhizoid. × 1100.
- Fig. 116b. Medullar hyphae. × 1100.
- Fig. 117. Detail of upper cortex. × 1100.
- Fig. 118. Detail of upper cortex with extreme decortication. × 1100.
- Figs. 119a and b. Spermatiophores. × 1100.
- Fig. 120. Spermatia. × 1865.
- Fig. 121. Detail of cells from outer covering of spermagonium. × 1100.

Figs. 122–126. *Umbilicaria cristata.*
- Fig. 122. Section of thallus. × 55.
- Fig. 123. Longitudinal-section of central thallus attachment. × 18.
- Fig. 124. Cross-section of central thallus attachment. × 18.
- Fig. 125. Cells from base of central attachment as seen in longitudinal view. × 1100.
- Fig. 126. Detail of upper cortex. × 434.



SECOND BYRD ANTARCTIC EXPEDITION

Explanation of Plate

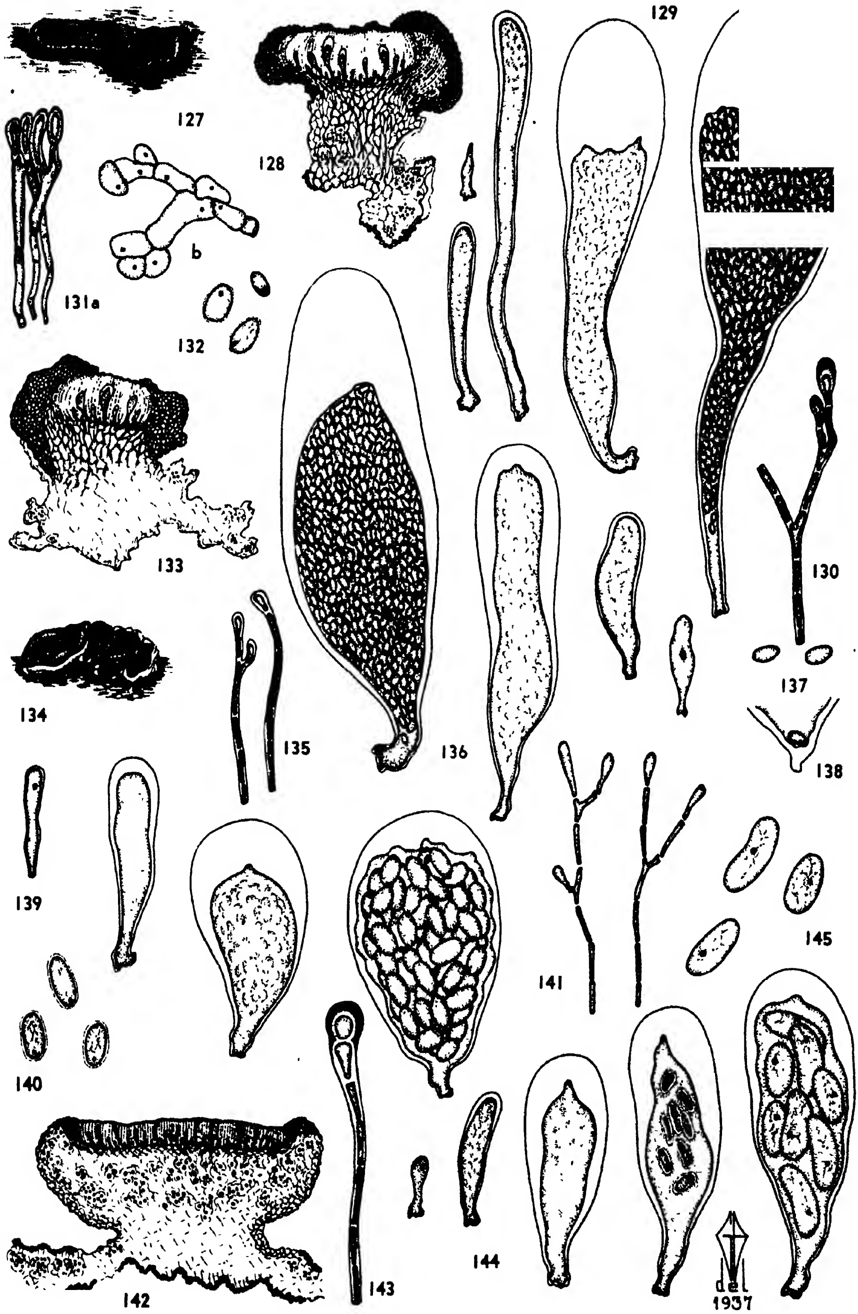
PLATE 46

Figs. 127–132. *Sarcogyne angulosa.*
Fig. 127. Habit sketch of apothecia. × 27.
Fig. 128. Section through thallus and apothecium. × 114.
Fig. 129. Development of ascus through maturity. × 1100.
Fig. 130. Paraphysis. × 1100.
Fig. 131a. Cells from the apex of the parathecium. × 1100.
Fig. 131b. Detail of hyphae from the thallus medulla. × 1100.
Fig. 132. Mature spores. × 1100. One spore from developing ascus showing nuclear condition. × 1865.

Figs. 133–138. *Sarcogyne grisea.*
Fig. 133. Section through apothecium and thallus. × 55.
Fig. 134. Habit sketch. × 14.
Fig. 135. Paraphyses. × 1100.
Fig. 136. Ascus development through maturity. × 1100.
Fig. 137. Mature spores. × 1865.
Fig. 138. Detail of ascus showing spore at very base. × 1100.

Figs. 139–141. *Biatorella arachnoidea.*
Fig. 139. Development of ascus through maturity. × 1100.
Fig. 140. Mature spores. × 1100.
Fig. 141. Paraphyses. × 1100.

Figs. 142–145. *Lecanora carbonacea.*
Fig. 142. Section through an apothecium and part of thallus. × 104.
Fig. 143. Paraphysis. × 1100.
Fig. 144. Development of ascus through maturity. × 1100.
Fig. 145. Mature spores. × 1100.

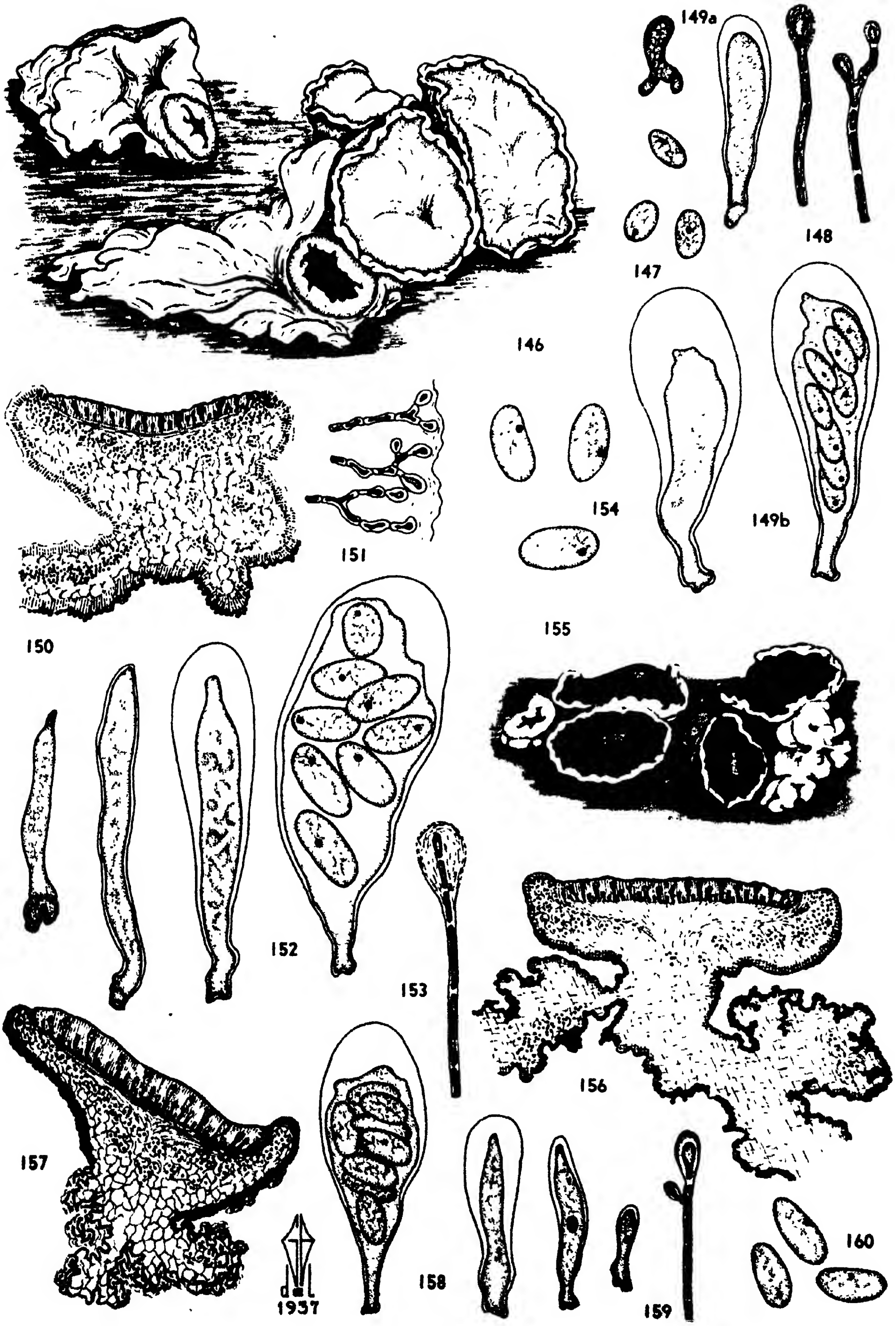


SECOND BYRD ANTARCTIC EXPEDITION

Explanation of Plate

PLATE 47

Figs. 146–151. *Lecanora Siplei.*
Fig. 146. Habit sketch of apothecia and thallus. × 20.
Fig. 147. Mature spores. × 1100.
Fig. 148. Paraphyses. × 1100.
Fig. 149a. Young asci. × 1100.
Fig. 149b. Older asci. × 1100.
Fig. 150. Section through apothecium and a portion of thallus. × 35.
Fig. 151. Detail of fastigiate thalline margin. × 1100.
Figs. 152–156. *Lecanora griseomarginata.*
Fig. 152. Development of ascus through maturity. × 1100.
Fig. 153. Paraphysis with a gelatinous head. × 1100.
Fig. 154. Mature spores. × 1100.
Fig. 155. Habit sketch of apothecia and thallus. × 20.
Fig. 156. Section through apothecium and thallus. × 55.
Figs. 157–160. *Lecanora lilacina.*
Fig. 157. Section through apothecium and thallus showing associated foreign algae. × 55.
Fig. 158. Development of ascus through maturity. × 1100.
Fig. 159. Paraphysis. × 1100.
Fig. 160. Mature spores. × 1100.



SECOND BYRD ANTARCTIC EXPEDITION

Explanation of Plate

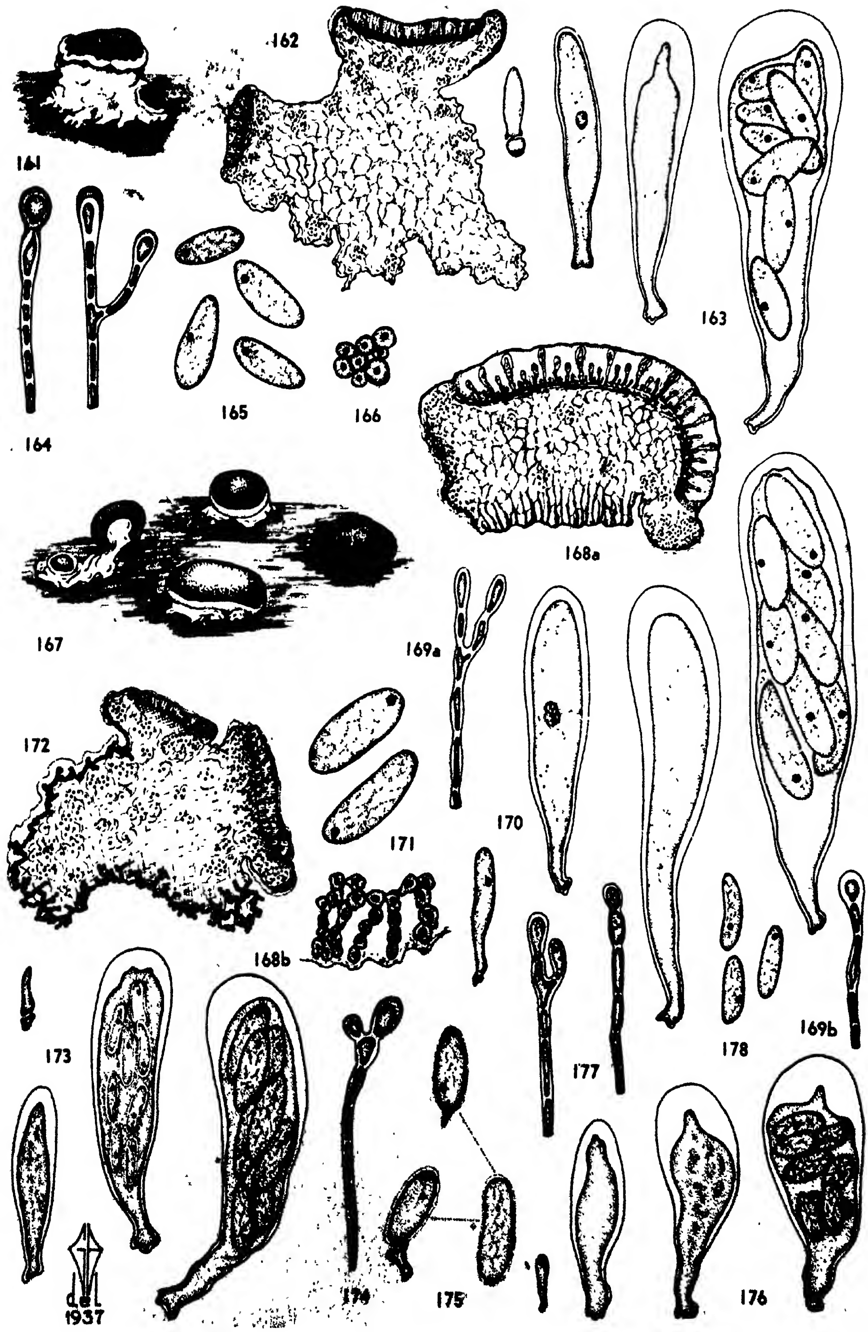
PLATE 48

Figs. 161–166. *Lecanora lilacinofusca.*
Fig. 161. Habit sketch of thallus with apothecia. × 20.
Fig. 162. Section of thallus and apothecia. × 55.
Fig. 163. Development of ascus through maturity. × 1100.
Fig. 164. Paraphyses. × 1100.
Fig. 165. Mature spores. × 1100.
Fig. 166. Detail of cells from the outer margin adjacent to the apothecium. × 1100.

Figs. 167–171. *Lecanora subolivacea.*
Fig. 167. Habit sketch of apothecia and thallus. × 35.
Fig. 168a. Section of apothecium and thallus. × 55.
Fig. 168b. Detail of thallus margin. × 1100.
Figs. 169a and b. Paraphyses. × 1100.
Fig. 170. Development of ascus through maturity. × 1100.
Fig. 171. Mature spores. × 1100.

Figs. 172–175. *Lecanora fuscobrunnea.*
Fig. 172. Section through thallus and apothecia. × 55.
Fig. 173. Development of ascus through maturity. × 1100.
Fig. 174. Paraphysis. × 1100.
Fig. 175. Mature spores, some with appendages. × 1100.

Figs. 176–178. *Candelariella albovirens.*
Fig. 176. Development of ascus through maturity. × 1100.
Fig. 177. Paraphyses. × 1100.
Fig. 178. Mature spores. × 1100.



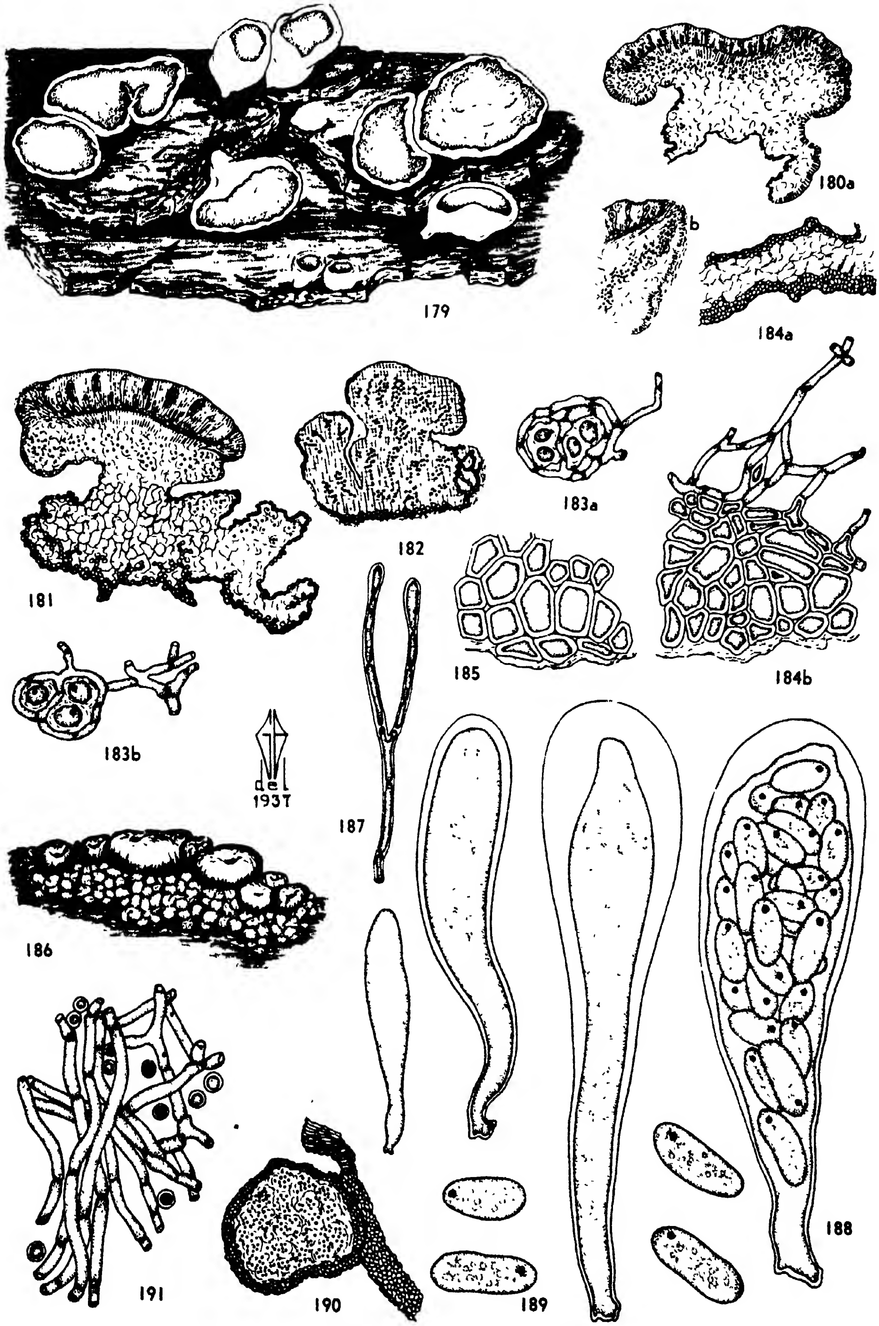
SECOND BYRD ANTARCTIC EXPEDITION

Explanation of Plate

PLATE 49

Figs. 179–180. *Candelariella albovirens.*
- Fig. 179. Habit sketch of apothecia. × 14.
- Fig. 180a. Section through apothecium and thallus. × 35.
- Fig. 180b. Portion of a section through an apothecium to show especially well-developed thalline margin. × 55.

Figs. 181–191. *Candelariella chrysea.*
- Fig. 181. Section through apothecium and thallus. × 55.
- Fig. 182. Section through assimilative areola. × 55.
- Fig. 183a. Algae surrounded by parasitic hyphae; from an assimilative areola. × 735.
- Fig. 183b. Algae and hyphae from below the apothecium. × 1100.
- Fig. 184a. Non-assimilative thallus. × 55.
- Fig. 184b. Basal cortex of non-assimilative thallus. × 434.
- Fig. 185. Basal cortex of assimilative thallus. × 735.
- Fig. 186. Habit sketch of assimilative thallus with apothecia. × 10.
- Fig. 187. Paraphysis. × 1100.
- Fig. 188. Development of ascus through maturity. × 1100.
- Fig. 189. Mature spores. × 1100.
- Fig. 190. Section through an isidium. × 177.
- Fig. 191. Detail of medullar hyphae. × 434.



SECOND BYRD ANTARCTIC EXPEDITION

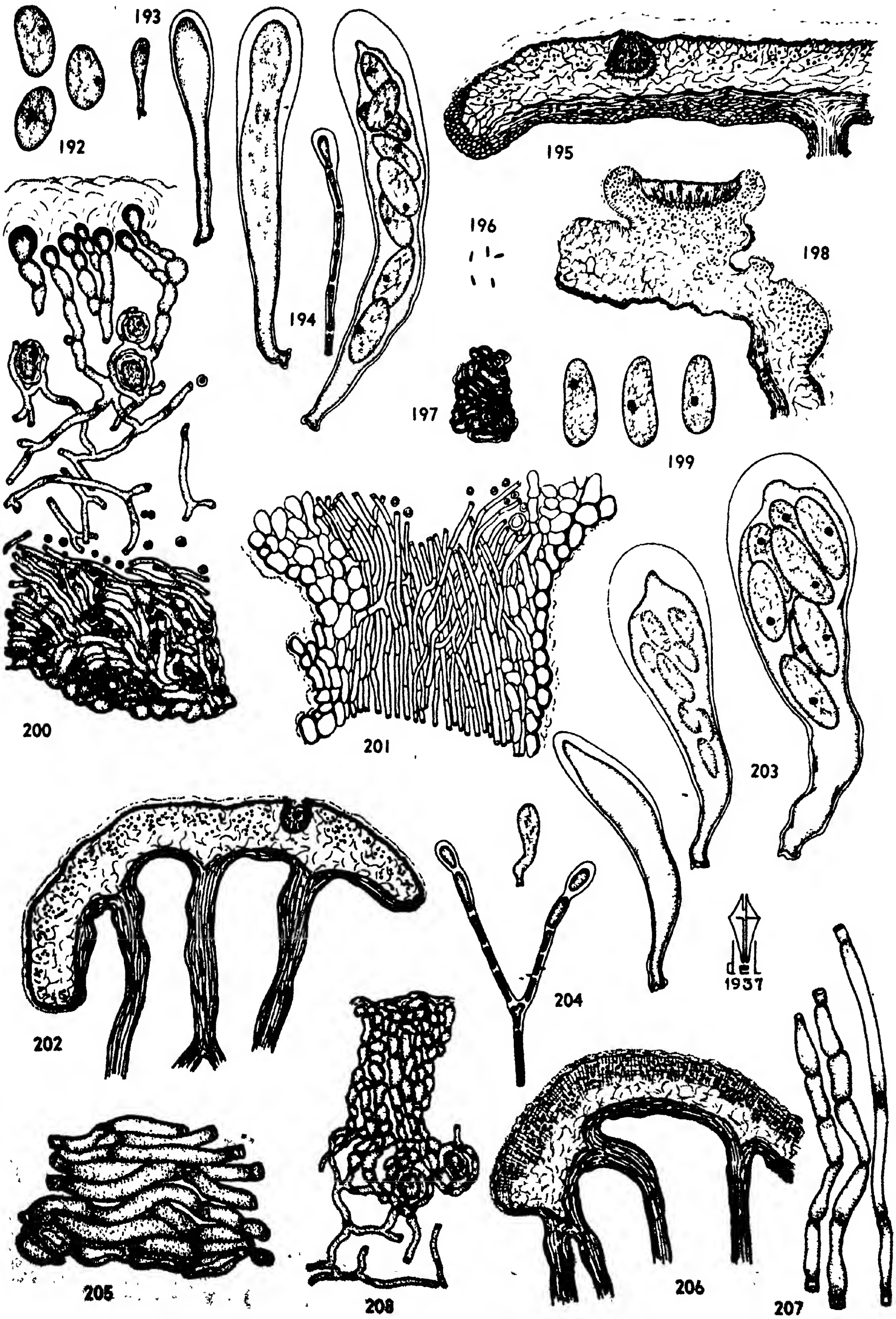
Explanation of Plate

PLATE 50

Figs. 192–201. *Parmelia variolosa.*
- Fig. 192. Mature spores. × 1100.
- Fig. 193. Development of ascus through maturity. × 1100.
- Fig. 194. Paraphysis. × 1100.
- Fig. 195. Section of thallus with spermagonium. × 104.
- Fig. 196. Spermatia. × 1100.
- Fig. 197. Detail of cells from spermagonium wall. × 1100.
- Fig. 198. Section through apothecium and thallus. × 55.
- Fig. 199. Mature spores. × 1100.
- Fig. 200. Detail of thallus from upper through lower surface. × 434.
- Fig. 201. Detail of rhizoid. × 434.

Figs. 202–204. *Parmelia Coreyi.*
- Fig. 202. Section of thallus and spermagonium. × 55.
- Fig. 203. Development of ascus through maturity. × 1100.
- Fig. 204. Paraphysis. × 1100.

Figs. 205–208. *Parmelia griseola.*
- Fig. 205. Detail of lower cortex. × 1100.
- Fig. 206. Section of thallus. × 55.
- Fig. 207. Detail of cells from surface of rhizoid inwards. × 1100.
- Fig. 208. Upper cortex and medulla. × 434.



SECOND BYRD ANTARCTIC EXPEDITION

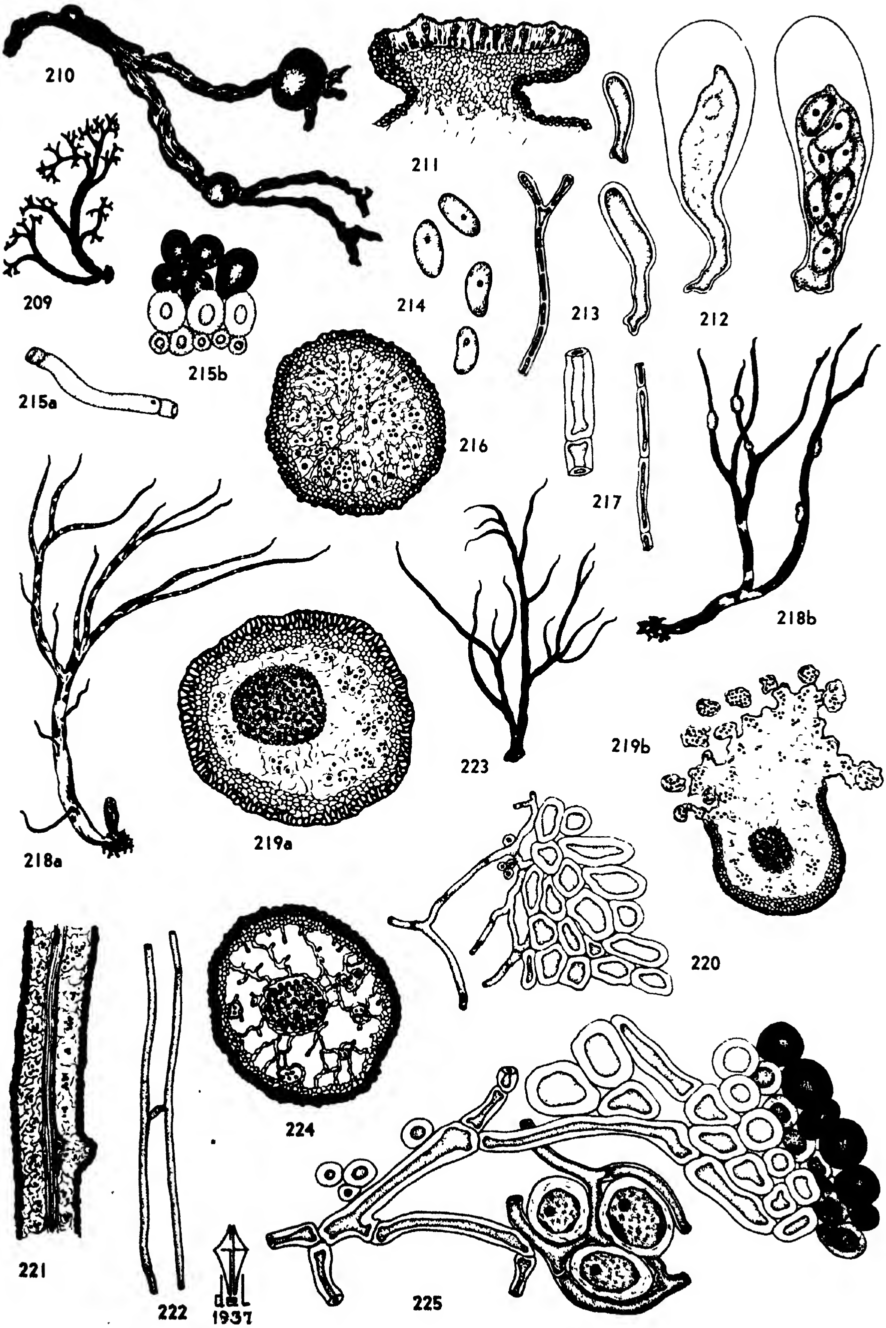
Explanation of Plate

PLATE 51

Figs. 209–216. *Alectoria antarctica.*
- Fig. 209. Habit sketch. × 6.
- Fig. 210. Detail of thallus ends with apothecia. × 35.
- Fig. 211. Section of apothecium. × 55.
- Fig. 212. Development of ascus through maturity. × 1100.
- Fig. 213. Paraphysis. × 1100.
- Fig. 214. Mature spores. × 1100.
- Fig. 215a. Hypha from medulla. × 1100.
- Fig. 215b. Detail of cortex. × 1100.
- Fig. 216. Cross-section of thallus. × 177.

Figs. 217–222. *Usnea antarctica.*
- Fig. 217. Hyphae from medulla. × 1100.
- Fig. 218a. Habit sketch of radiate thallus with alternate dark and light bands. × 2.
- Fig. 218b. Habit sketch of radiate thallus entirely black except for scattered yellow floccose pustules. × 2.
- Fig. 219a. Cross-section of thallus, type illustrated in fig. 218a. × 104.
- Fig. 219b. Cross-section of thallus, type illustrated in fig. 218b. × 55.
- Fig. 220. Detail of medulla and cortex junction. × 1100.
- Fig. 221. Longitudinal-section of thallus, type fig. 218a. × 18.
- Fig. 222. Hyphae from chondroid axis in longtitudinal view. × 1100.

Figs. 223–225. *Usnea frigida.*
- Fig. 223. Habit sketch. × 3.
- Fig. 224. Cross-section of thallus. × 104.
- Fig. 225. Detail of cells from central "stele" to cortex. × 1100.

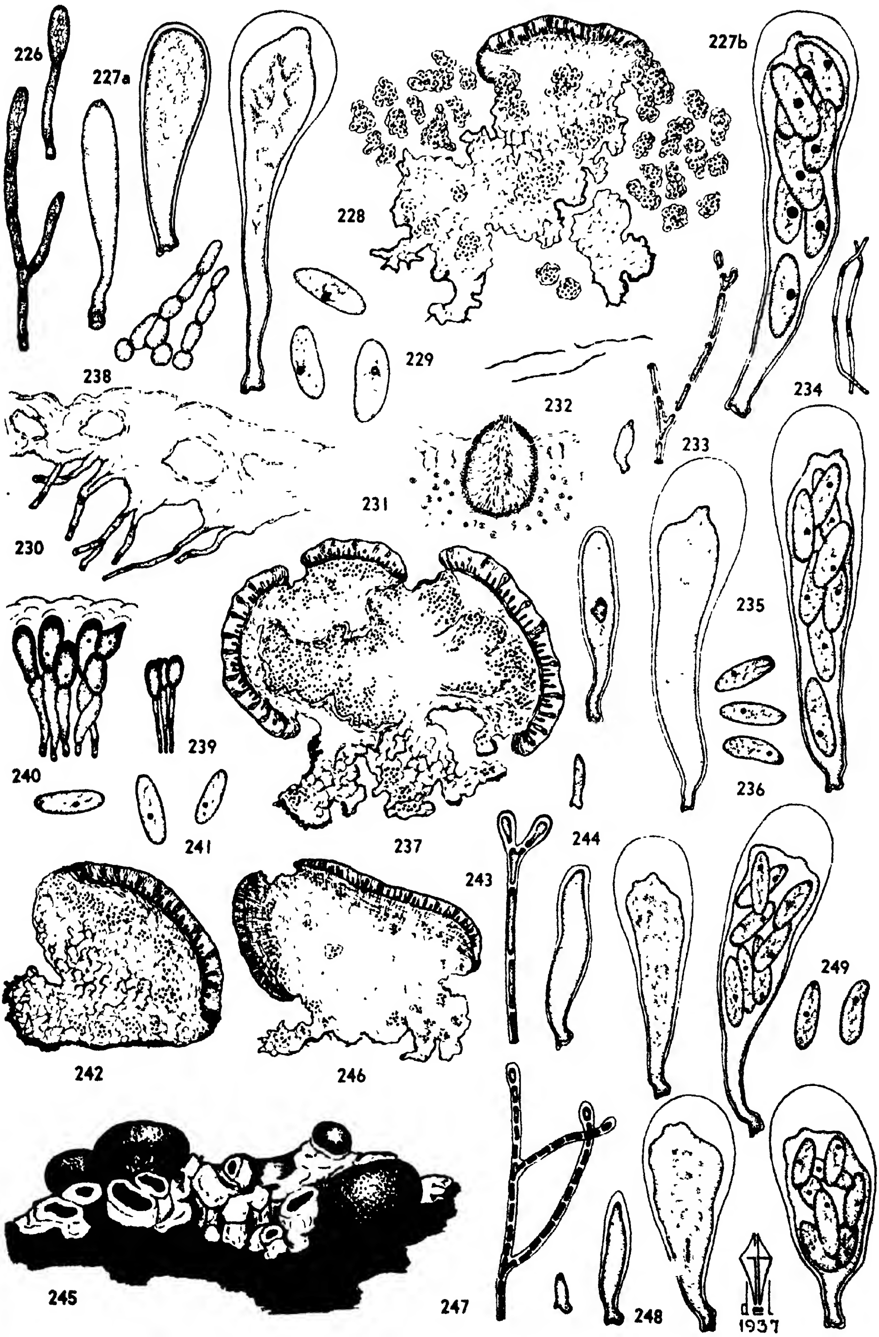


SECOND BYRD ANTARCTIC EXPEDITION

EXPLANATION OF PLATE

PLATE 52

Figs. 226–229. *Protoblastenia flava.*
Fig. 226. Paraphyses. × 1100.
Fig. 227. Development of ascus through maturity. × 1100.
Fig. 228. Section through thallus and apothecium. × 55.
Fig. 229. Mature spores. × 1100.
Figs. 230–238. *Protoblastenia aurea.*
Fig. 230. Detail of decomposed cortex in spermagonial region. × 1100.
Fig. 231. Detail of spermagonium. × 177.
Fig. 232. Spermatia. × 1100.
Fig. 233. Paraphysis. × 1100.
Fig. 234. Medullar hyphae. × 1100.
Fig. 235. Development of ascus through maturity. × 1100.
Fig. 236. Mature spores. × 1100.
Fig. 237. Section of apothecia and thallus. × 18.
Fig. 238. Marginal cells. × 1100.
Figs. 239–245. *Protoblastenia alba.*
Fig. 239. Detail of marginal parathecial cells. × 1100.
Fig. 240. Detail of marginal thallus cells. × 1100.
Fig. 241. Mature spores. × 1100.
Fig. 242. Section of thallus with apothecium. × 55.
Fig. 243. Paraphysis. × 1100.
Fig. 244. Development of ascus through maturity. × 1100.
Fig. 245. Habit sketch of thallus and apothecia in various stages of development. × 14.
Figs. 246–249. *Protoblastenia citrinigricans.*
Fig. 246. Section through apothecia and thallus. × 35.
Fig. 247. Paraphysis. × 1100.
Fig. 248. Development of ascus. × 1100.
Fig. 249. Mature spores. × 1100.



SECOND BYRD ANTARCTIC EXPEDITION

Explanation of Plate

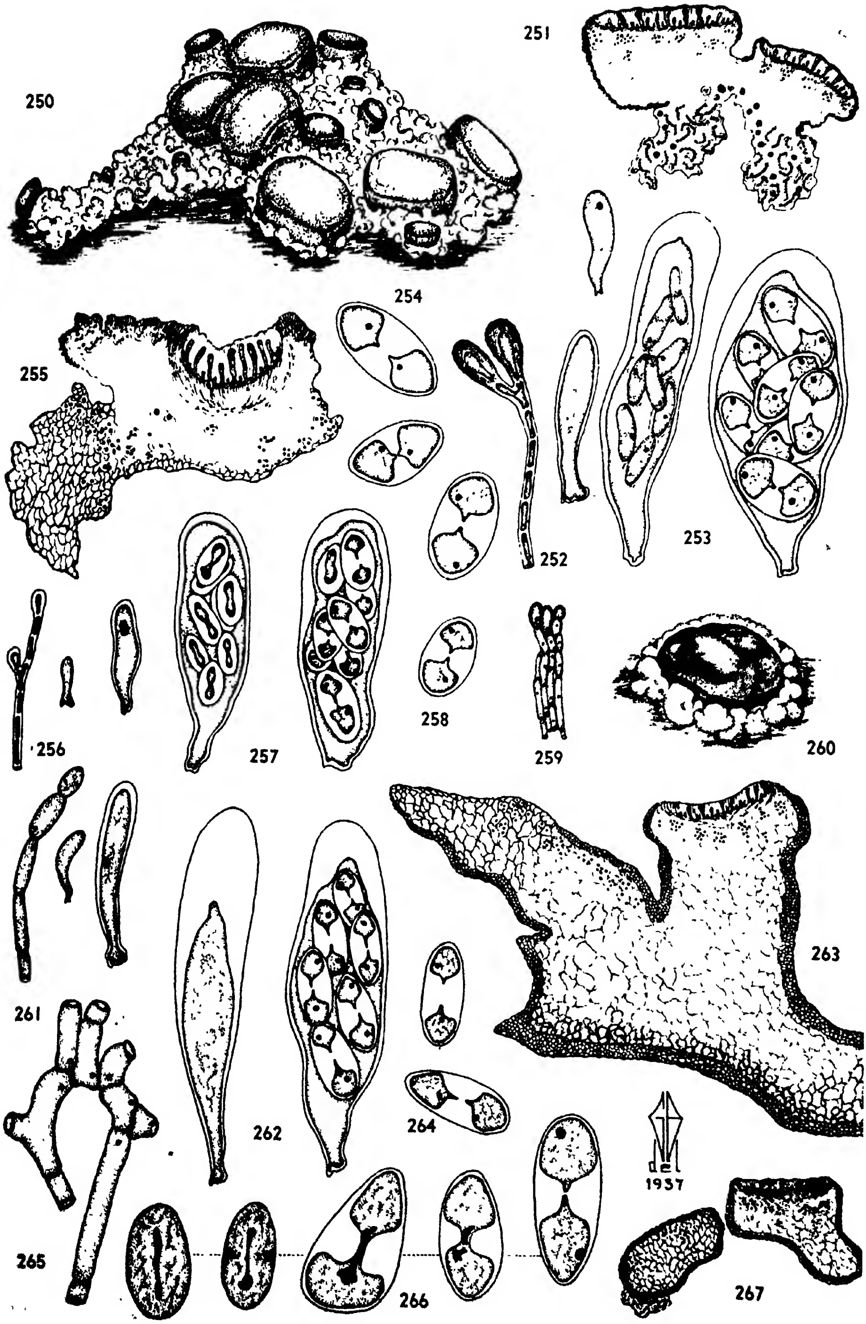
PLATE 53

Figs. 250–254. *Blastenia succinea.*
- Fig. 250. Habit sketch. × 35.
- Fig. 251. Section through apothecia showing associated basal algae. × 55.
- Fig. 252. Paraphysis. × 1100.
- Fig. 253. Development of ascus through maturity. × 1100.
- Fig. 254. Mature spores showing variation in size and shape. × 1100.

Figs. 255–260. *Blastenia grisea.*
- Fig. 255. Section through thallus and apothecium. × 104.
- Fig. 256. Paraphysis. × 1100.
- Fig. 257. Development of ascus through maturity. × 1100.
- Fig. 258. Mature spore. × 1100.
- Fig. 259. Detail from upper marginal cortex of the thallus. × 1100.
- Fig. 260. Habit sketch. × 27.

Figs. 261–266. *Kuttlingeria rufa.*
- Fig. 261. Paraphysis. × 1100.
- Fig. 262. Development of ascus through maturity. × 1100.
- Fig. 263. Section through thallus and apothecium. × 55.
- Fig. 264. Mature spores. × 1100.
- Fig. 265. Medullar hyphae. × 1100.
- Fig. 266. Development of spores showing nuclear-division stages preceding the formation of the mature spore, the latter with two distinct cells, each uninucleate. × 1865.

Fig. 267. *Kuttlingeria rutilans.* Section through thallus lobe and apothecium. × 35.



SECOND BYRD ANTARCTIC EXPEDITION

EXPLANATION OF PLATE

PLATE 54

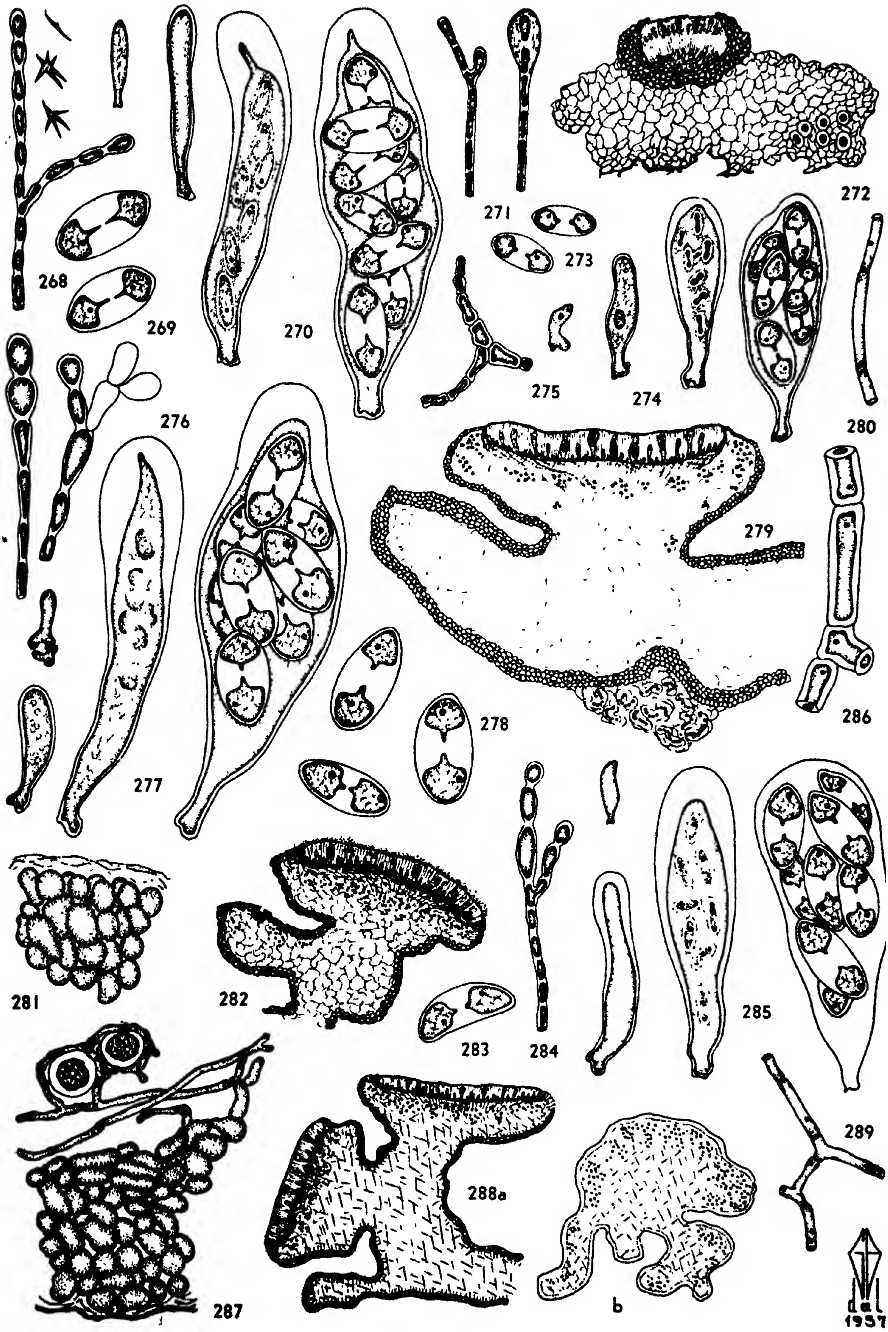
Figs. 268–270. *Kuttlingeria rutilans.*
- Fig. 268. Paraphysis and crystals from the epithecium. × 1100.
- Fig. 269. Mature spores. × 1100.
- Fig. 270. Development of ascus through maturity. × 1100.

Figs. 271–275. *Huea flava.*
- Fig. 271. Paraphyses. × 1100.
- Fig. 272. Section through thallus and apothecium. × 145.
- Fig. 273. Mature spores. × 1100.
- Fig. 274. Development of ascus through maturity. × 1100.
- Fig. 275. Detail of hyphae from medulla. × 1100.

Figs. 276–280. *Polycauliona pulvinata.*
- Fig. 276. Paraphyses. × 1100.
- Fig. 277. Development of ascus through maturity. × 1100.
- Fig. 278. Mature spores. × 1100.
- Fig. 279. Section through thallus and apothecium. × 55.
- Fig. 280. Detail of medullar hypha. × 1100.

Figs. 281–286. *Polycauliona sparsa.*
- Fig. 281. Detail of upper cortex. × 1100.
- Fig. 282. Section through thallus and apothecium. × 35.
- Fig. 283. Mature spore. × 1100.
- Fig. 284. Paraphysis. × 1100.
- Fig. 285. Development of ascus through maturity. × 1100.
- Fig. 286. Detail of medullar hyphae. × 1100.

Figs. 287–289. *Gasparrinia Siplei.*
- Fig. 287. Detail of lower cortex. × 1100.
- Fig. 288a and b. Section through apothecia and thallus lobe respectively. × 35.
- Fig. 289. Detail of medullar hyphae. × 1100.



SECOND BYRD ANTARCTIC EXPEDITION

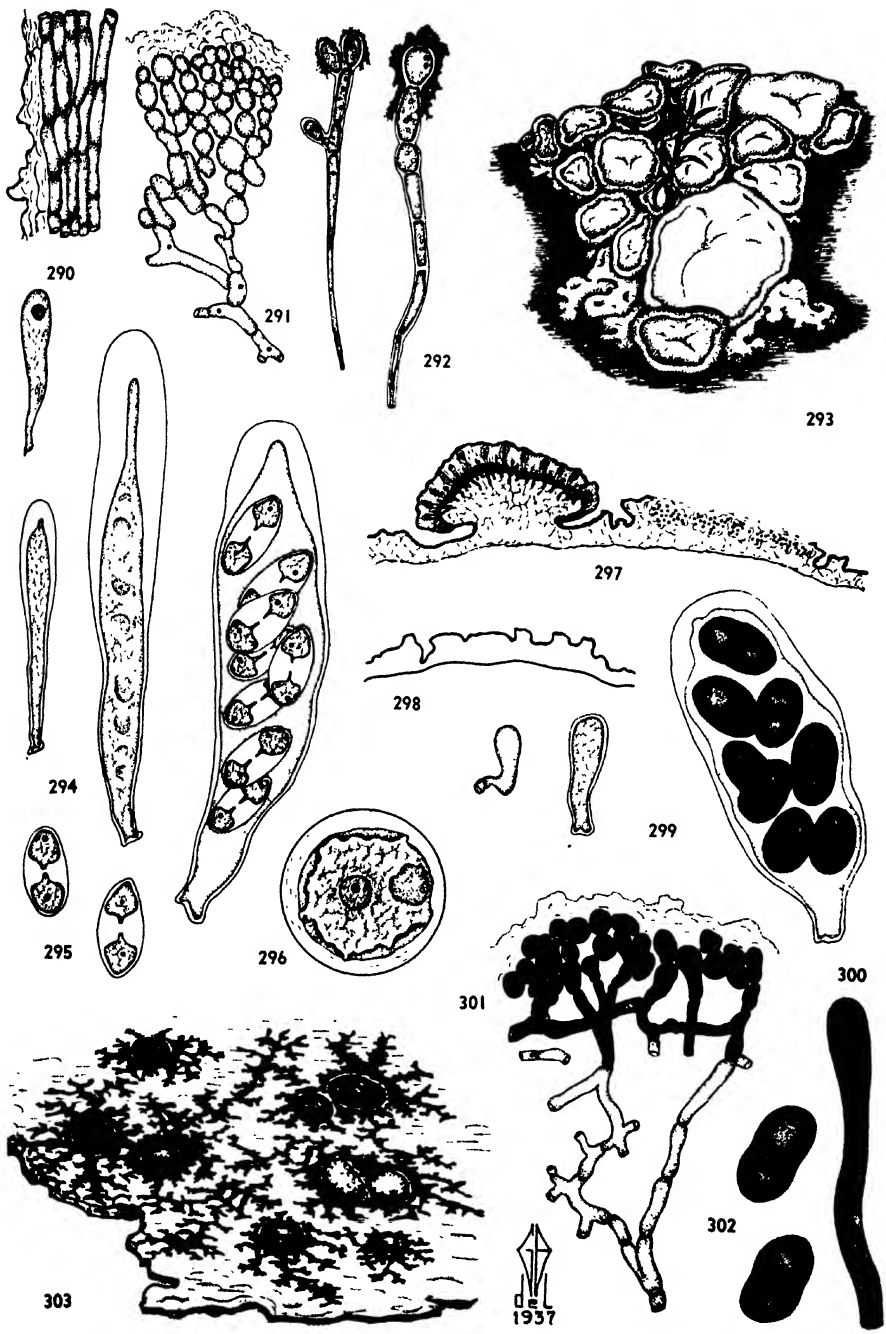
EXPLANATION OF PLATE

PLATE 55

Figs. 290–296. *Gasparrinia Siplei.*
- Fig. 290. Detail of cells from rhizoidal attachment. × 1100.
- Fig. 291. Detail of upper cortex with decorticating layers. × 1100.
- Fig. 292. Paraphyses. × 1100.
- Fig. 293. Habit sketch. × 14.
- Fig. 294. Development of ascus through maturity. × 1100.
- Fig. 295. Mature spores. × 1100.
- Fig. 296. Alga from thallus. × 1865.

Figs. 297–302. *Buellia flavoplana.*
- Fig. 297. Section through apothecium and assimilative areola. × 35.
- Fig. 298. Section through non-assimilative thallus. × 35.
- Fig. 299. Development of ascus through maturity. × 1100.
- Fig. 300. Paraphysis. × 1100.
- Fig. 301. Detail of non-assimilative areola. × 1100.
- Fig. 302. Mature spores. × 1100.

Fig. 303. *Buellia stellata.* Habit sketch. × 25.



SECOND BYRD ANTARCTIC EXPEDITION

Explanation of Plate

PLATE 56

Figs. 304–307. *Buellia stellata.*

Fig. 304. Paraphyses. × 1100.

Figs. 305a and b. Sections through thalli and apothecium. × 104.

Figs. 306a and b. Mature spores from various sources. × 1100.

Fig. 307. Development of ascus through maturity. × 1100.

Figs. 308–311. *Buellia chrysea.*

Fig. 308. Detail of cells from inner part of non-assimilative thallus. × 1100.

Fig. 309. Detail of cells from outer surface of non-assimilative thallus. × 1100.

Fig. 310. Mature spores. × 1100.

Fig. 311. Section through non-assimilative, assimilative thalli, and apothecium. × 55.

Figs. 312–315. *Buellia brunnescens.*

Fig. 312. Paraphysis. × 1100.

Fig. 313. Development of ascus through maturity. × 1100.

Figs. 314a and b. Sections through apothecium and assimilative thallus. × 104.

Fig. 315. Mature spores. × 1100.

Figs. 316–317. *Buellia chrysea.*

Fig. 316. Paraphysis. × 1100.

Fig. 317. Development of ascus through maturity. × 1100.

Figs. 318–321. *Buellia pallida.*

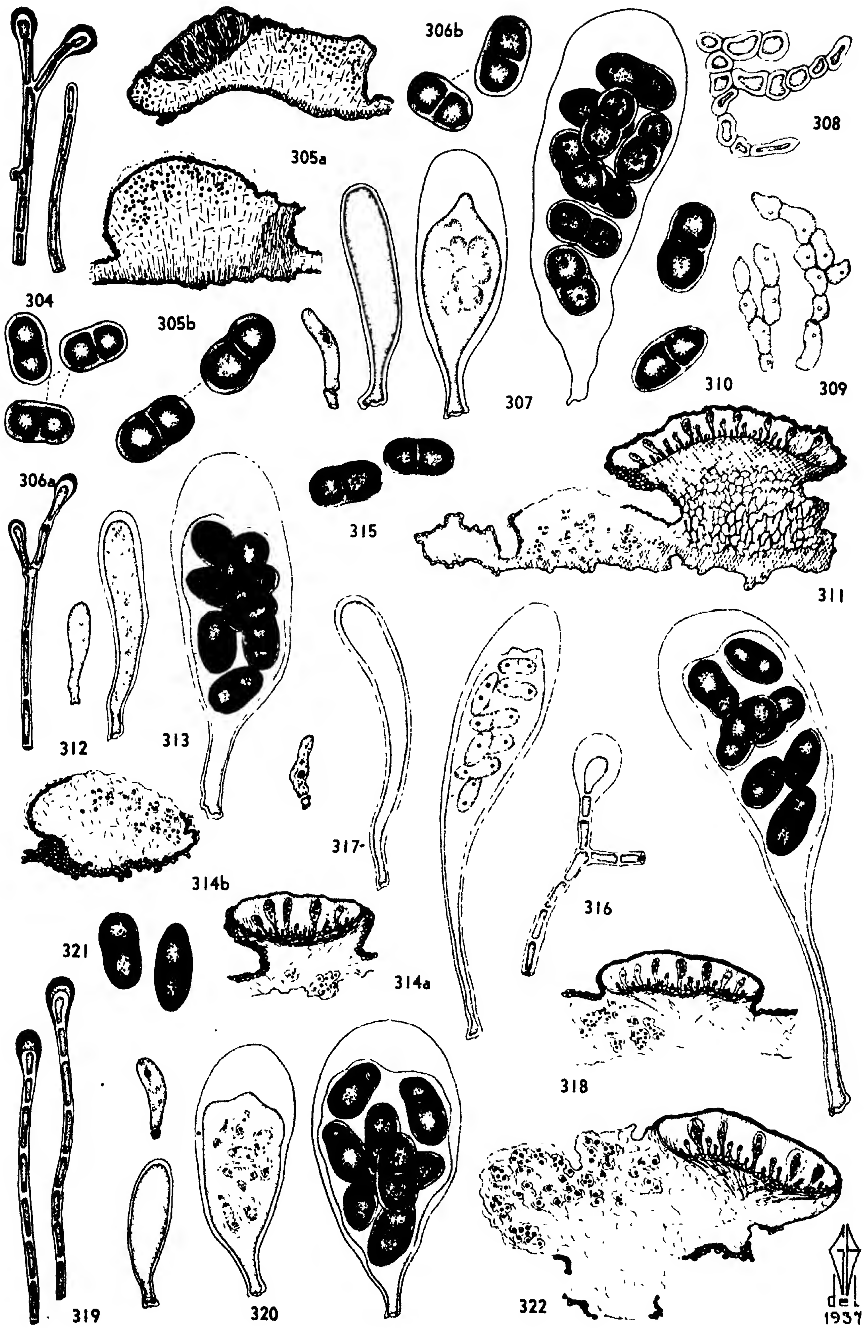
Fig. 318. Section through thallus and apothecium. × 104.

Fig. 319. Paraphysis. × 1100.

Fig. 320. Development of ascus through maturity. × 1100.

Fig. 321. Mature spores. × 1100.

Fig. 322. *Buellia alboradians.* Section through thallus and apothecium. × 177.

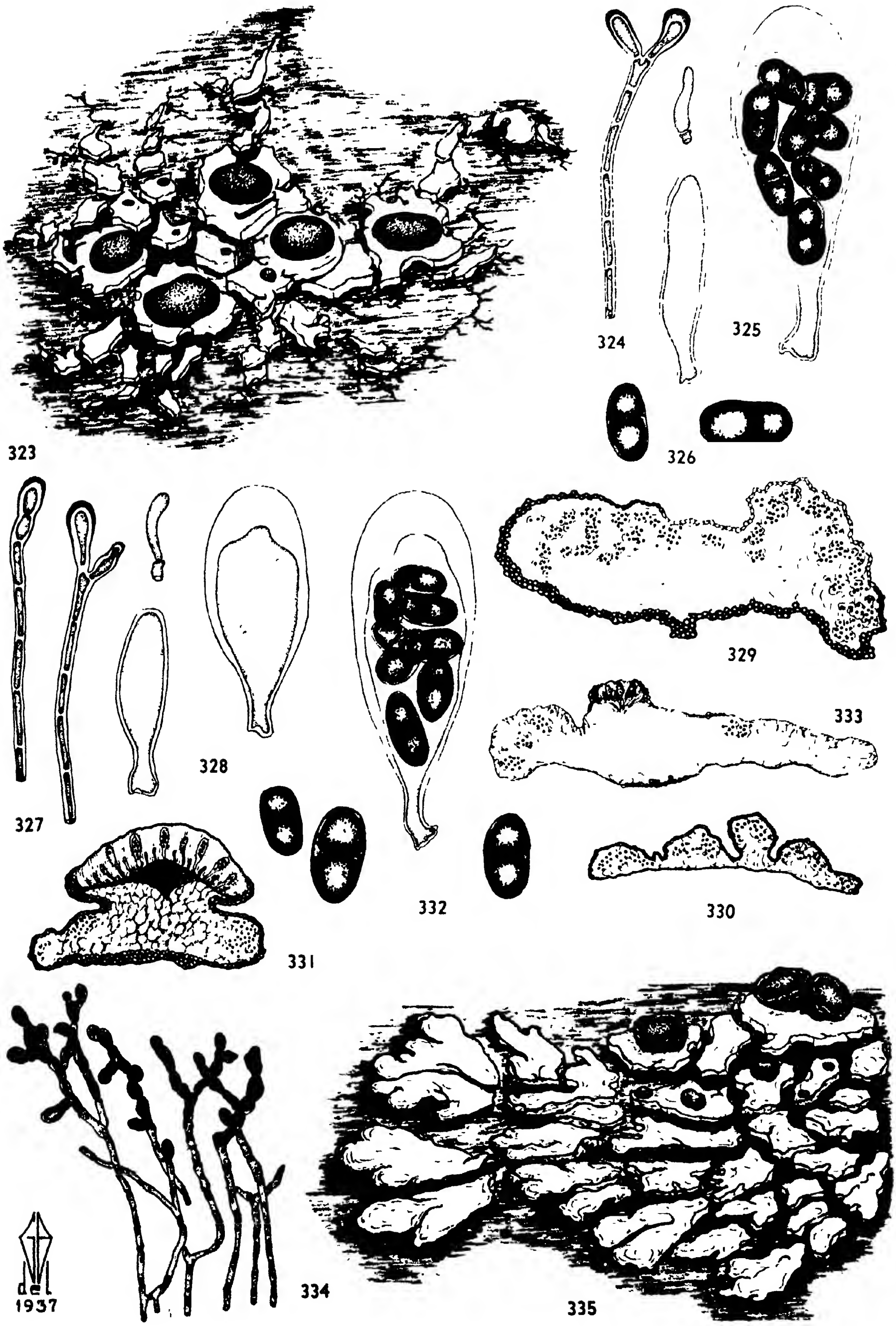


SECOND BYRD ANTARCTIC EXPEDITION

Explanation of Plate

PLATE 57

Figs. 323–326. ***Buellia alboradians.***
Fig. 323. Habit sketch. × 35.
Fig. 324. Paraphysis. × 1100.
Fig. 325. Development of ascus through maturity. × 1100.
Fig. 326. Mature spores. × 1100.
Figs. 327–332. ***Buellia frigida.***
Fig. 327. Paraphyses. × 1100.
Fig. 328. Development of ascus through maturity. × 1100.
Fig. 329. Section through assimilative thallus. × 55.
Fig. 330. Section through darkened assimilative thallus at margin of plant. × 55.
Fig. 331. Section through apothecium. × 55.
Fig. 332. Mature spores. × 1100.
Figs. 333–334. ***Buellia floccosa.***
Fig. 333. Section through thallus and apothecium. × 55.
Fig. 334. Detail of outer cortex. × 434.
Fig. 335. ***Buellia frigida.*** Habit sketch. × 20.



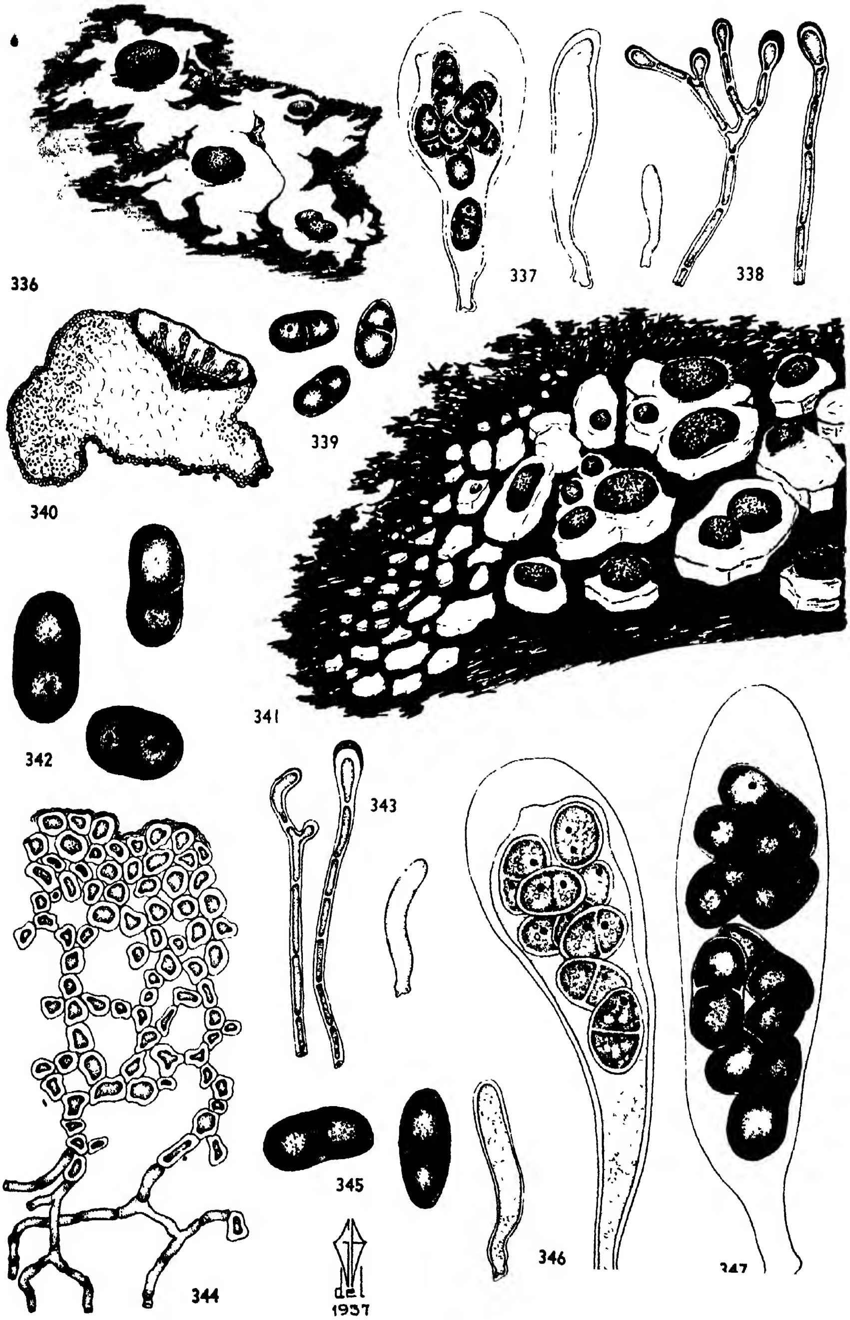
SECOND BYRD ANTARCTIC EXPEDITION

Explanation of Plate

PLATE 58

Figs. 336–339. *Buellia floccosa.*
- Fig. 336. Habit sketch. × 40.
- Fig. 337. Development of ascus through maturity. × 1100.
- Fig. 338. Paraphyses. × 1100.
- Fig. 339. Mature spores. × 1100.

Figs. 340–347. *Buellia olivaceobrunnea.*
- Fig. 340. Section through thallus and apothecium. × 104.
- Fig. 341. Habit sketch. × 25.
- Fig. 342. Mature spores. × 1865.
- Fig. 343. Paraphyses. × 1100.
- Fig. 344. Detail of medulla and cortex. × 434.
- Fig. 345. Mature spores. × 1100.
- Figs. 346–347. Development of ascus through maturity. × 1100.



SECOND BYRD ANTARCTIC EXPEDITION

Explanation of Plate

PLATE 59

Figs. 348–353. *Buellia muscicola.*

Fig. 348a. Bulbil from a young plant. × 1100.

Fig. 348b. Beginning of bulbil formation. × 1100.

Fig. 349a. Habit sketch of very young thallus. × 35.

Fig. 349b. Habit sketch of apothecium and thallus with non-assimilative strands still prominent. × 35.

Fig. 349c. Mature plant. × 35.

Fig. 350. Mature spores. × 1100.

Fig. 351. Section through apothecium and thallus. × 104.

Fig. 352. Paraphyses showing stages in development. × 1100.

Fig. 353. Development of ascus through maturity. × 1100.

Figs. 354–357. *Buellia grisea.*

Fig. 354a. Section through non-assimilative thallus. × 104.

Fig. 354b. Section through assimilative thallus and apothecium. × 55.

Fig. 355. Paraphysis. × 1100.

Fig. 356. Development of ascus through maturity. × 1100.

Fig. 357. Mature spores. × 1100.

Figs. 358–362. *Buellia dendritica.*

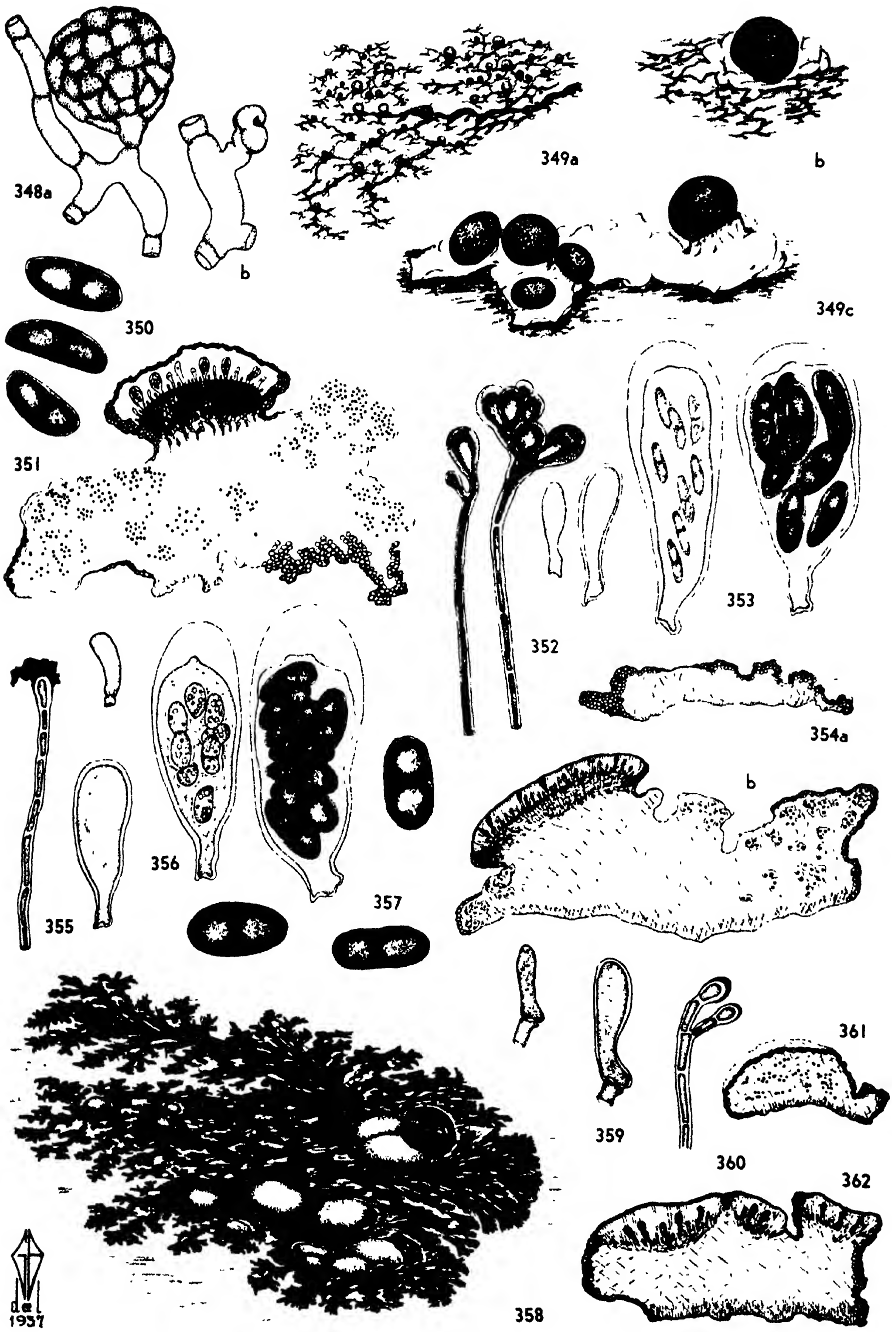
Fig. 358. Habit sketch. × 25.

Fig. 359. Young ascus stages. × 1100.

Fig. 360. Paraphysis. × 1100.

Fig. 361. Section through assimilative areola. × 104.

Fig. 362. Section through apothecia. × 104.



SECOND BYRD ANTARCTIC EXPEDITION

Explanation of Plate

PLATE 60

Figs. 363–364. *Buellia dendritica.*

Fig. 363. Development of ascus through maturity, including an abnormal 2-spored ascus with vestiges of the other spores. × 1100.

Fig. 364. Mature spores. × 1100.

Figs. 365–369. *Buellia albida.*

Fig. 365. Habit sketch. × 35.

Fig. 366. Paraphysis. × 1100.

Fig. 367. Development of ascus through maturity, including an abnormal 2-spored ascus. × 1100.

Fig. 368. Mature spores. × 1100.

Fig. 369. Section through thallus and apothecium. × 177.

Figs. 370–375. *Buellia Russellii.*

Fig. 370. Habit sketch. × 35.

Fig. 371. Section through thallus and apothecium. × 104.

Fig. 372a. Developing spore with canal still present between the two cells. × 1865.

Fig. 372b. Spores showing successive development. × 1100.

Fig. 373. Paraphysis. × 1100.

Fig. 374. Development of ascus through maturity. × 1100.

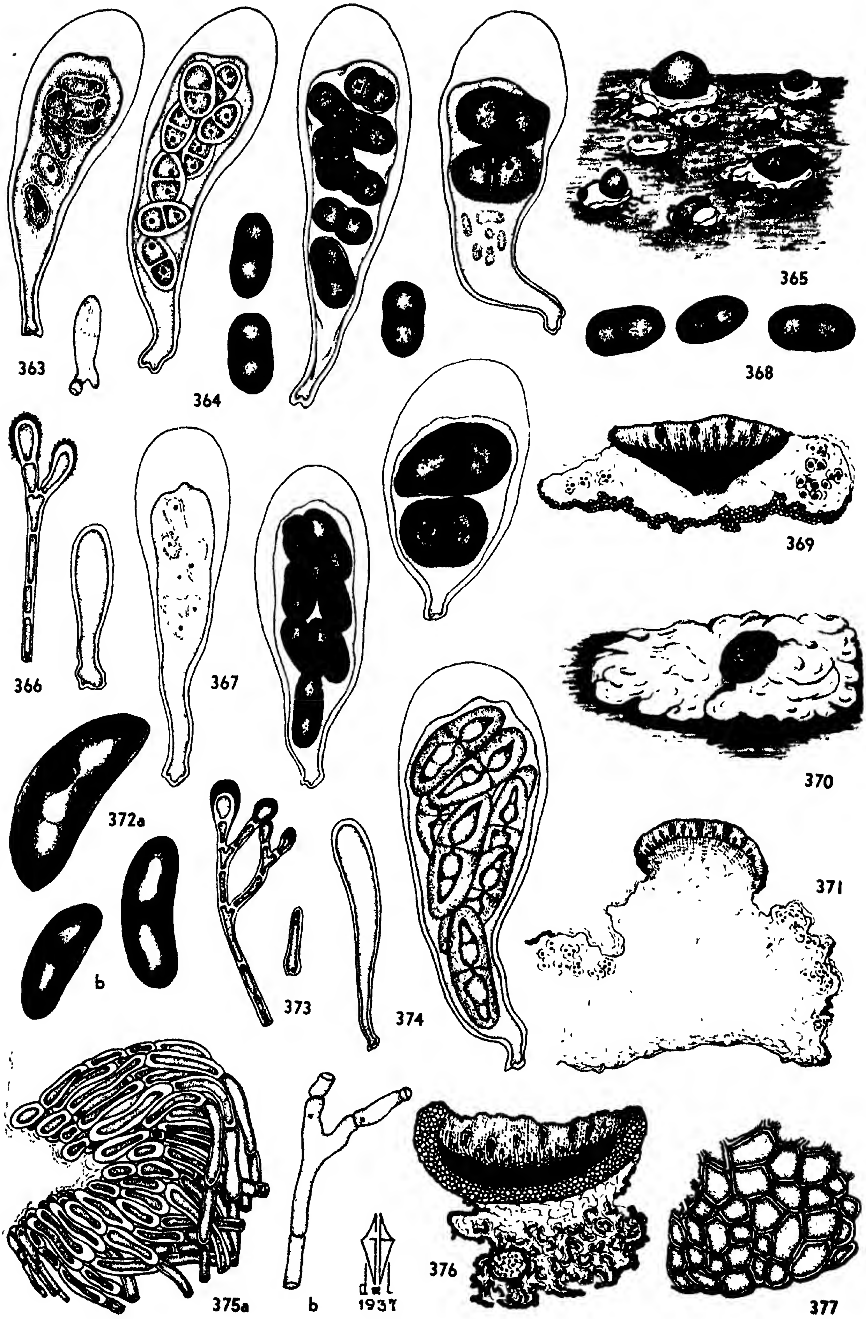
Fig. 375a. Cells from thallus margin and adjoining epithecium. × 1100.

Fig. 375b. Medullar hyphae. × 1100.

Figs. 376–377. *Buellia (Diplotomma) Siplei.*

Fig. 376. Section through thallus and basal algae. × 104.

Fig. 377. Detail of basal parathecium. × 1100.

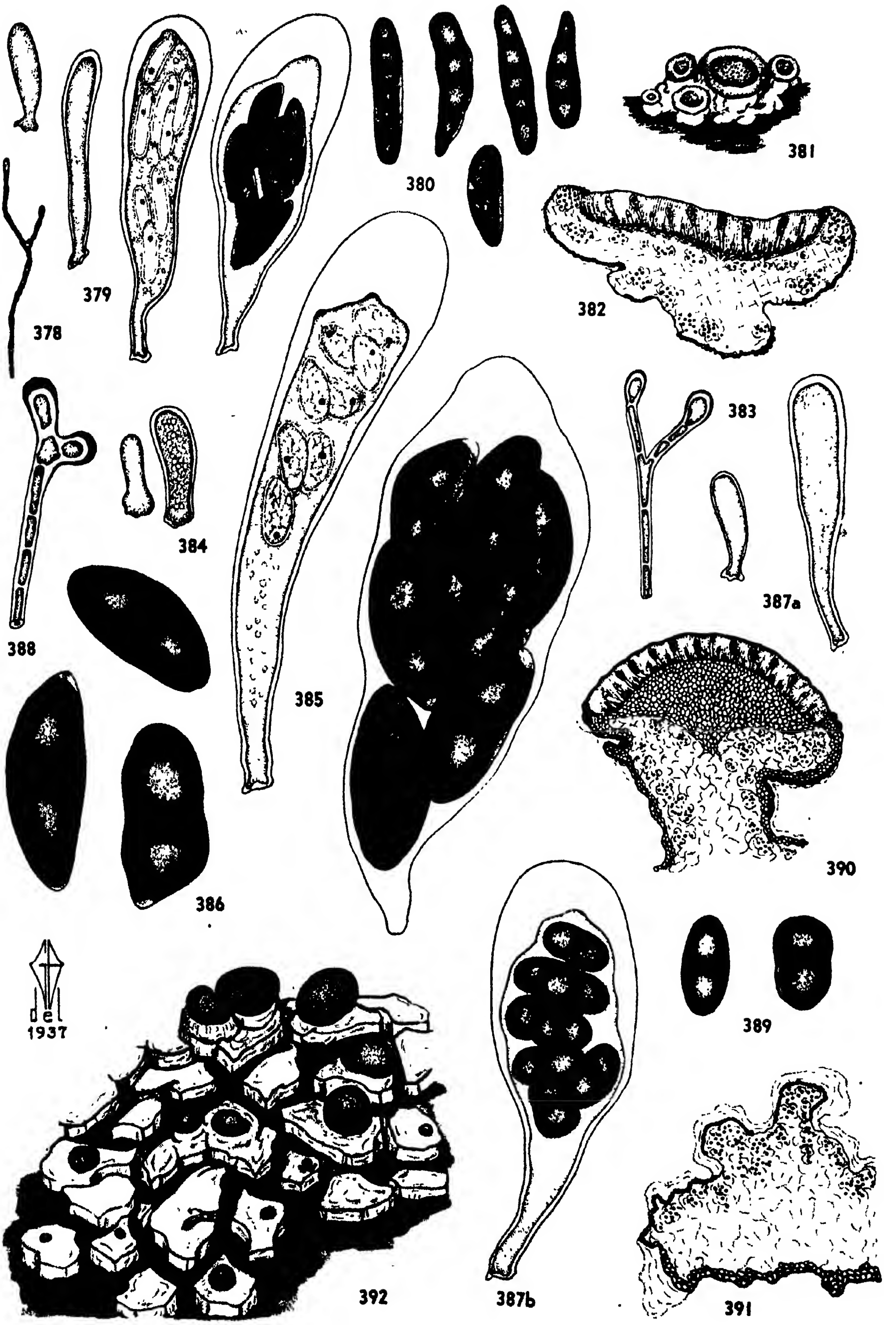


SECOND BYRD ANTARCTIC EXPEDITION

Explanation of Plate

PLATE 61

Figs. 378–380. *Buellia (Diplotomma) Siplei.*
Fig. 378. Paraphysis. × 1100.
Fig. 379. Development of ascus. × 1100.
Fig. 380. Spores in varying degrees of maturity. × 1100.
Figs. 381–386. *Rinodina olivaceobrunnea.*
Fig. 381. Habit sketch. × 50.
Fig. 382. Section through apothecium. × 55.
Fig. 383. Paraphysis. × 1100.
Fig. 384. Young asci. × 1100.
Fig. 385. Older and mature asci. × 1100.
Fig. 386. Mature spores. × 1100.
Figs. 387–392. *Rinodina sordida.*
Figs. 387a and b. Development of ascus. × 1100.
Fig. 388. Paraphysis. × 1100.
Fig. 389. Mature spores. × 1100.
Fig. 390. Section through apothecium. × 55.
Fig. 391. Section through thallus. × 55.
Fig. 392. Habit sketch. × 20.

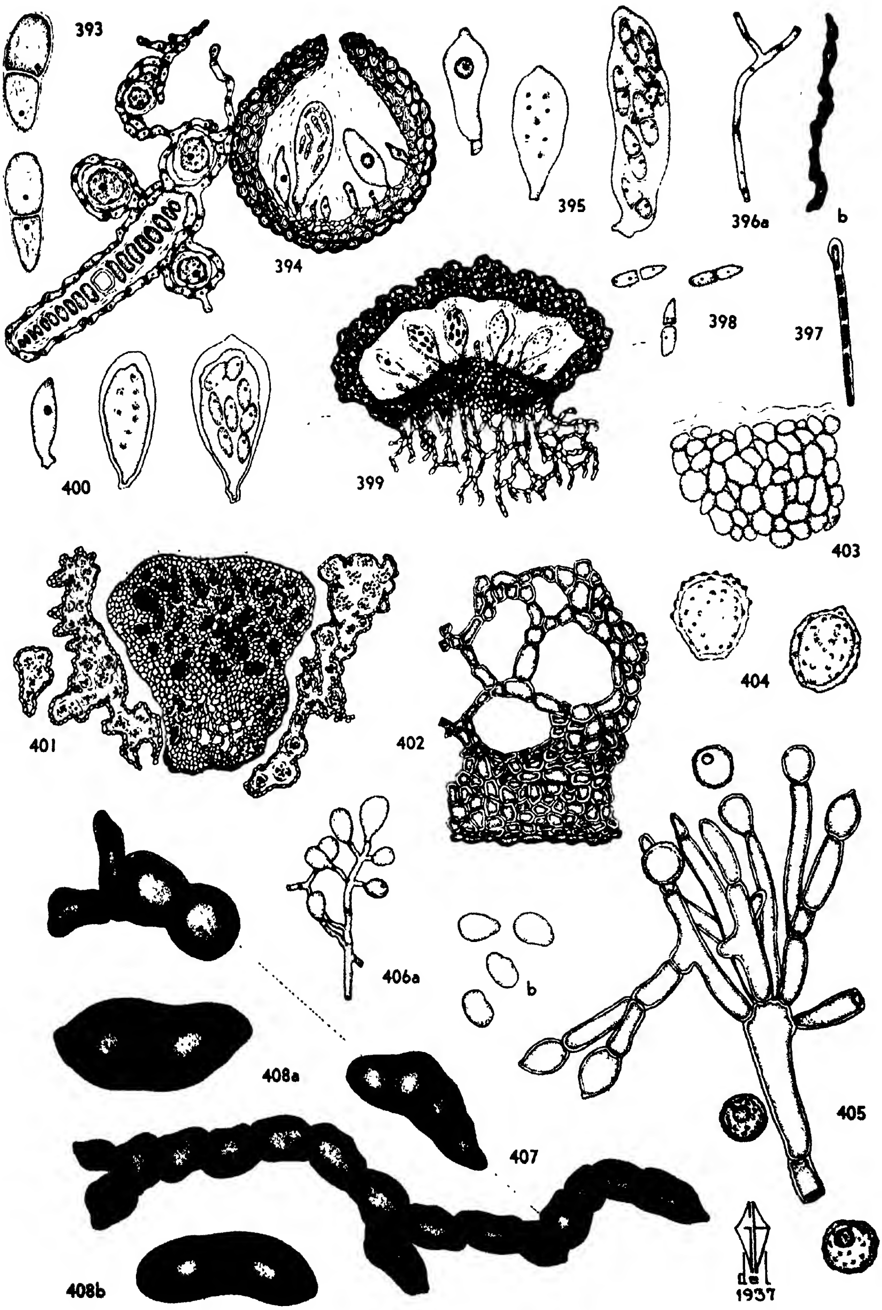


SECOND BYRD ANTARCTIC EXPEDITION

EXPLANATION OF PLATE

PLATE 62

Figs. 393–395. *Thelidium parvum.*
Fig. 393. Mature spores. × 1865.
Fig. 394. Perithecium and associated algae. × 434.
Fig. 395. Development of ascus. × 1100.
Figs. 396–400. *Diplonaevia Parmeliae.*
Fig. 396a. Detail of hyphae of host, *Parmelia.* × 1100.
Fig. 396b. Detail of hyphae of parasite. × 1100.
Fig. 397. Paraphysis. × 1100.
Fig. 398. Mature spores. × 1100.
Fig. 399. Section of apothecium, the host surface indicated by dotted lines. × 385.
Fig. 400. Development of ascus. × 1100.
Figs. 401–403. *Pyrenodesmia Darbishirei.*
Fig. 401. Section through thallus. × 55.
Fig. 402. Detail of basal cortex. × 735.
Fig. 403. Detail of upper cortex. × 735.
Figs. 404–406. *Scopulariopsis brevicaulis.*
Fig. 404. Conidia. × 1865.
Fig. 405. Conidiophores and conidia. × 1100.
Figs. 406a and b. *Botrytis* sp. Conidiophores and conidia. × 1865.
Fig. 407. *Hormiscium* sp. Hyphae. × 1100.
Fig. 408. *Rinodina* sp. Mature spores. × 1100; found in preparation of *Blastenia succinea* growing over *Umbilicaria cerebriformis* from Skua Gull Peak, *P. Siple & S. Corey 72W-15.* It is possible that some apothecium of *Rinodina* among those of *Blastenia* has been overlooked, as the material is scant and the apothecia are very small.



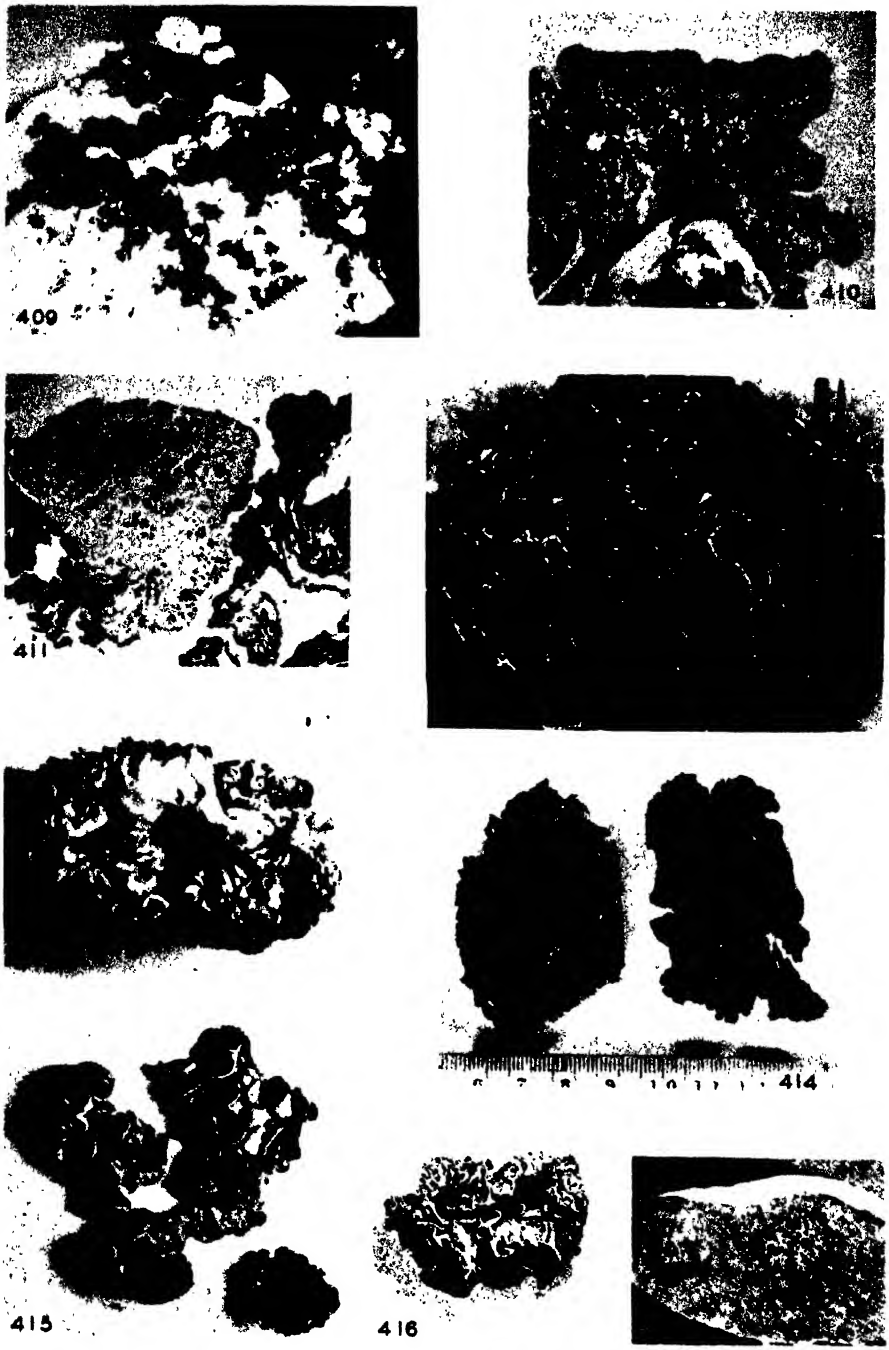
SECOND BYRD ANTARCTIC EXPEDITION

EXPLANATION OF PLATE

PLATE 63

All photographs were made by Mr. Verne Goerger.

Fig. 409. *Lecidea cancriformis.* Apothecia and thalli from Queen Maud Mts.
Fig. 410. *Lecidea Siplei.* Section through apothecium.
Fig. 411. *Pyrenodesmia Darbishirei.* Section through thallus.
Fig. 412. *Umbilicaria cerebriformis.* Skua Gull Peak, Marie Byrd Land. Thallus.
Fig. 413. *Lecanora Siplei.* Apothecia.
Fig. 414. *Umbilicaria rugosa.* Thallus.
Fig. 415. *Lecanora Siplei.* Apothecia.
Fig. 416. *Umbilicaria rugosa.* Thallus, natural size.
Fig. 417. *Pannoparmelia pellucida* and *P. delicata.* Thallus, natural size.



SECOND BYRD ANTARCTIC EXPEDITION

Explanation of Plate

PLATE 64

Fig. 418. *Pannoparmelia pellucida,* showing extensive hypothallus. × 8.

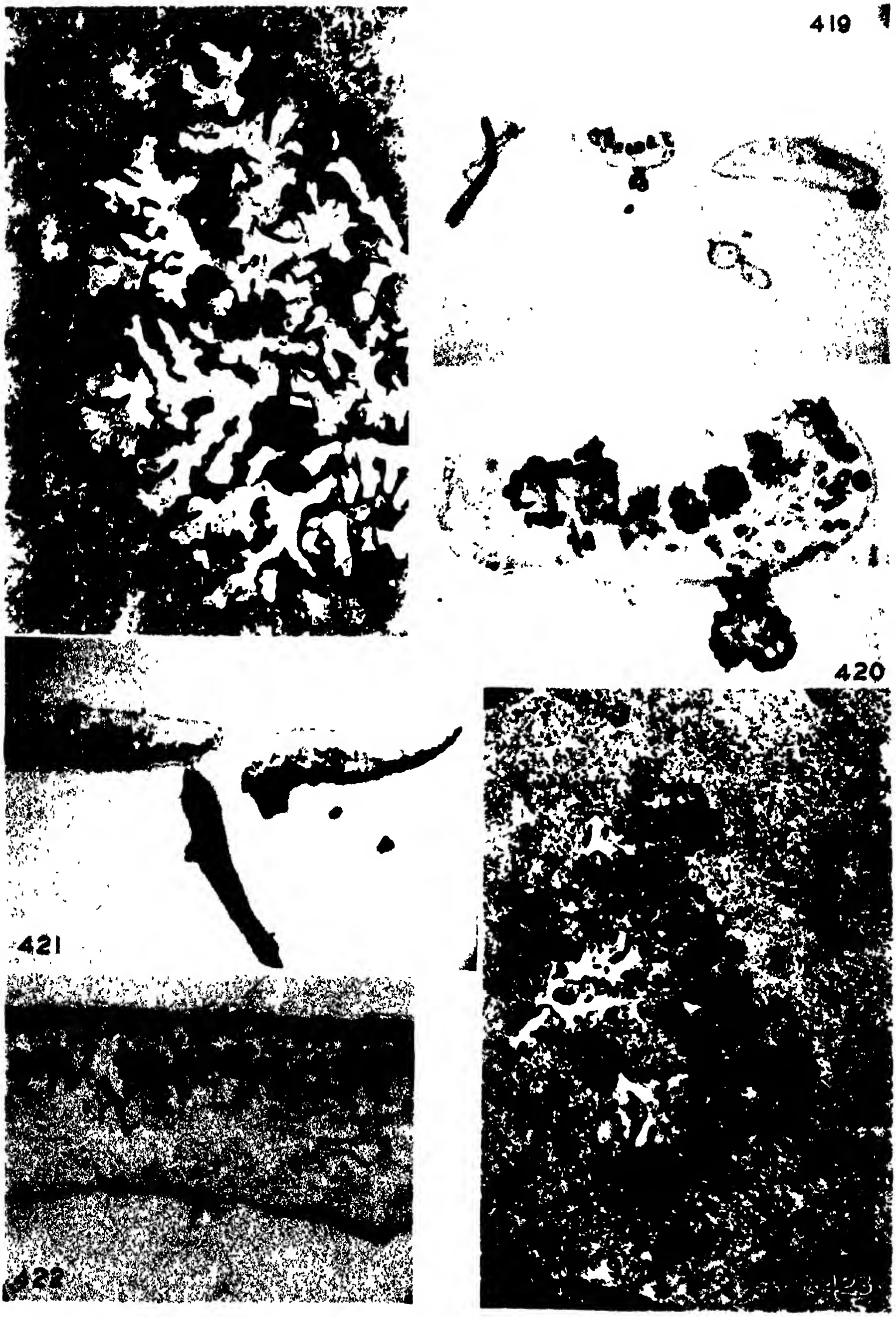
Fig. 419. *Pannoparmelia delicata,* section showing apothecium and lobe of thallus. × 115.

Fig. 420. *Pannoparmelia delicata,* section of apothecium, showing trace of hymenium, which is mostly replaced by soredia. Note large thick-walled dark cells at the right which may be a bit of cortex, or may belong to a parasite. × 500.

Fig. 421. *Pannoparmelia pellucida,* section through two lobes of thallus, showing a portion of a branching rhizina. × 800.

Fig. 422. *Pannoparmelia pellucida.* Details of thalline structure. × 2500.

Fig. 423. *Pannoparmelia delicata.* Thallus × 8.

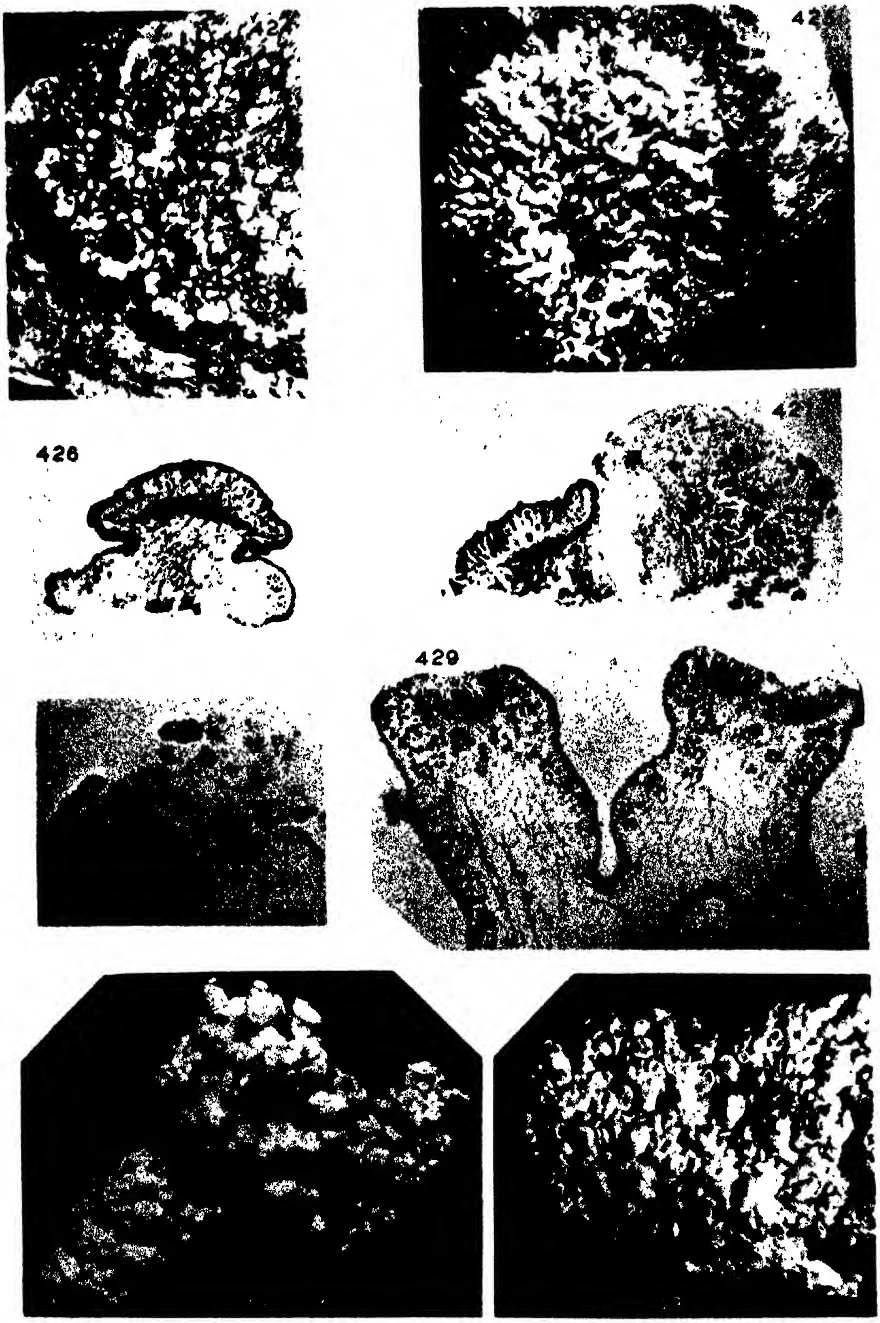


SECOND BYRD ANTARCTIC EXPEDITION

Explanation of Plate

PLATE 65

Fig. 424. *Buellia flavoplana.* Thallus on rock.
Fig. 425. *Kuttlingeria rufa.* Fruiting thallus on rock.
Fig. 426. *Rhizocarpon flavum.* Section of apothecium.
Fig. 427. *Buellia frigida.* Section of fruiting thallus.
Fig. 428. *Catillaria arachnoidea.* Section of thallus with apothecia.
Fig. 429. *Gasparrinia Siplei.* Thallus with apothecia in section.
Fig. 430. *Polycauliona pulvinata.* Fruiting thallus.
Fig. 431. *Gasparrinia Siplei.* Fruiting thallus.



SECOND BYRD ANTARCTIC EXPEDITION

III. Mosses

EDWIN B. BARTRAM

The mosses collected by Mr. Siple in Marie Byrd Land and King Edward VII Land in connection with the Second Byrd Antarctic Expedition represent five distinct species. *Grimmia Antarctici* is easily the dominant type, comprising the greater part of the collections both in number and quantity. *Barbula Byrdii* and *Sarconeurum glaciale* rank next in the order of abundance, and the two Bryums, *B. Siplei* and *B. antarcticum,* occur sparingly in small tufts.

It is not without significance that these mosses, in a broad way, are closely allied to some of the most cosmopolitan specific types such as *Grimmia apocarpa* and *Bryum argenteum.* A common origin within comparatively recent times is the inference that might be drawn from these facts.

Growing as they do on true nunataks surrounded by perpetual ice, hundreds of miles from the nearest known vegetation in any direction, the natural query is "where did these mosses come from?" Introduction through the agency of birds or by means of air currents is possible but hardly probable. A more likely theory is that these colonies are representative of a few extremely hardy, vigorous remnants of a former climax vegetation that have managed to maintain a hold on life in the face of increasingly rigorous conditions of almost unbelievable severity.

The types of the new species are in the writer's herbarium, and duplicate sets of the series will no doubt be distributed by Mr. Siple to the representative herbaria both here and abroad.

Tortulaceae

Sarconeurum glaciale (Hook. f. & Wils.) Card. & Bryhn, Nat. Antarct. [Discovery] Exp. Musci. 3. 1907.

Didymodon ? glaciale Hook. f. & Wils., Crypt. Bot. Antarct. Voy. Erebus & Terror. 102. *pl. 152. f. 6.* 1845.

Sarconeurum antarcticum Bryhn, Nyt Mag. Naturvidensk. **40**: 205. 1902.

Type: Graham Land, Cockburn Island, 64° S., 57° W., *J. D. Hooker, S. antarcticum* based on S. Victoria Land, Geikie Land, Newnes Land, 6.5 m., *C. E. Borchgrevink.*

This species has been recorded from several stations in the Antarctic continent in addition to those listed here. It resembles *Tortula lithophila* Dus., of Fuegia, in some particulars but seems to be thoroughly distinct in the larger, arcuate-spreading, gradually acuminate leaves with larger and more coarsely papillose lamina cells. The fruit is unknown.

On highly metamorphosed slates and granite.

MARIE BYRD LAND: Edsel Ford Range, Lichen Peak, *P. Siple & S. Corey 46, 51, G-1;* Skua Gull Peak, *P. Siple & S. Corey 7a;* Mt. Corey, *P. Siple & S. Corey, 43a.*
SOUTH VICTORIA LAND: Geikie Land, Newnes Land, 6.5 m., *C. E. Borchgrevink.*

BARBULA **Byrdii** Bartram, sp. nov.

Type: Marie Byrd Land, Edsel Ford Range, Lichen Peak, *P. Siple & S. Corey G.*

Caespites brunneo-virides, compacti, intus radiculosi. Caules circa 1 cm. alti, parce ramosi. Folia minuta, erecto-patentia, sicca imbricata, vix 1 mm. longa et 0.5 mm. lata, ovata, concava, breviter et late acuminata vel acuta; marginibus recurvis, superne papilloso-crenulatis; costa valida, fusca, circa 60 μ lata, percurrente; cellulae superiores rotundato-quadratae, papillosae, 8–10 μ latae, basilares breviter rectangulares. Caetera ignota.

Densely tufted plants, dull brownish green. Stems erect, sparingly branched, to 1 cm. high, matted together with radicles below. Leaves small, erect and closely imbricated when dry, slightly erect-spreading when moist, scarcely 1 mm. long and 0.5 mm. wide, ovate, abruptly short-acuminate to acute, concave; margins erect and papillose-crenulate above, narrowly recurved in the median portion and erect and entire below; costa strong, brownish, ending in or just below the apex, papillose on both sides above, 50–60 μ wide, tapering slightly, if any, upward, in cross-section showing a median row of about five large guide cells with two layers of slightly smaller cells on the ventral side and about three layers of small, substereid cells on the dorsal side; upper cells small, obscure, papillose, irregularly rounded-quadrate, 8–10 μ in diameter, not incrassate, basal cells short-rectangular, smooth and pellucid near the insertion. Sporophyte unknown.

On highly metamorphosed slates and biotite sericite.

The broadly ovate, short-pointed leaves, with recurved margins and a strong percurrent costa, are typical of *Barbula* in a general way, but I know of no species in particular with which these plants might be closely compared. In some ways *Barbula Byrdii* is reminiscent of a small form of *Tortula atrovirens* (Sm.) Lindb. but the costa is not appreciably widened above and the structure in cross-section is quite different.

It is a privilege to associate Admiral Richard E. Byrd's name with this singular species, unlike any that has been described from Antarctica.

MARIE BYRD LAND: Edsel Ford Range, Lichen Peak, *P. Siple & S. Corey G*, type, *51a;* Skua Gull Peak, *P. Siple & S. Corey 1a, 4, 8, 99a;* Mt. Donald Woodward, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff 97a.*

GRIMMIACEAE

GRIMMIA ANTARCTICI Cardot, Bull. Herb. Boissier. II. **6**: 15. 1907.

Type: Graham Land, Louis Philippe Land, Cape Kjellman, *Skottsberg 448*, Ile Paulet, *Skottsberg 449.*

On biotite sericite, highly metamorphosed slates and granites.

The collections referred here vary widely in color, appearance, and habit, but after careful study I am convinced that they are all representative of one specific concept. The modifications are possibly the result of the varied and unusual conditions under which they manage to exist. Several well-developed capsules show the typical rudimentary peristome and, in the more luxuriant tufts, the characteristic spiral arrangement of the stem leaves is often very obvious.

From Skua Gull Peak, no. 1 is typical with several perfectly developed capsules; no. 99, plants developing numerous flagelliform microphyllous branches; no. 49, mixed with a small tuft of *Bryum Siplei;* no. 7, brownish green, well developed in luxuriant tufts about 2 cm. deep, stems copiously branched. A specimen from Chester Mts. or Skua Gull Peak is pale and considerably eroded but with stems to 1.5 cm. long, showing

spiral arrangement of the leaves to good advantage. From Chester Mts., no. 44 is in compact tufts, brown on the surface and blackish below, stems 2–2.5 cm. high, often with flagelliform branches; no. 40 is similar but slightly more robust and without the flagelliform branches. From Mt. Rea-Cooper, a bright vivid green form with short-tufted stem and flexuous, scarcely seriate leaves but structurally identical with the typical form; no. 2, a form with strongly sinuose leaf cells, almost rhacomitrioid in appearance but lacking the long hyaline hair points of var. *pilifera*. From Mt. Corey, No. 43 is brownish green, leaves slightly seriate, ovate-lanceolate, epilose or with a very short hyaline tip, flagelliform branches numerous; no. 97, Mt. Donald Woodward, a mixture of plants with epilose leaves and flagelliform lateral branches and the var. *pilifera* with hyaline-tipped leaves and the lamina cells strongly sinuose. From the more distant Mt. Helen Washington, no. 68 is a slender densely tufted form, olive green above and dark brown or blackish below, leaves mostly rounded at the tip and the costa vanishing well below the apex; no. 76 is well developed and fairly robust, golden brown, stems with numerous short tumid branches; no. 100a, relatively slender plants with numerous lateral flagelliform branches and with the terminal branches often short and congested in a capitulate cluster.

MARIE BYRD LAND: Edsel Ford Range, Skua Gull Peak, *P. Siple & S. Corey 1, 7, 49, 99;* Chester Mts., *P. Siple & S. Corey 40, 44;* Mt. Rea-Cooper, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff 2, 98a;* Mt. Corey, *P. Siple & S. Corey 43;* Mt. Donald Woodward, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff 97.*

KING EDWARD VII LAND: Rockefeller Mts., Mt. Helen Washington, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff 68, 76, 100a.*

var. **pilifera** Bartram, var. nov.

Type: Marie Byrd Land, Edsel Ford Range, Mt. Rea-Cooper, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff 27.*

Folia in pilum hyalinum producta; cellulae valde sinuosae.

Leaves with hyaline hair tips; lamina cells strongly sinuose. Leaves slightly seriate and with long conspicuous, hyaline tips, giving the tufts a hoary aspect very similar to some species of *Rhacomitrium,* lateral cell walls very sinuose.

On coarse-grained pink granite and biotite-sericite schist.

MARIE BYRD LAND: Edsel Ford Range, Mt. Rea-Cooper, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff 27, 98,* type; Mt. Donald Woodward, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff 97,* in part.

var. **percompacta** Bartram, var. nov.

Humillima, caespites perdensi.

Very small, compactly tufted plants, bright reddish brown; stems 4–5 mm. long, with short clustered branches above. Leaves often hyaline-bordered in the upper half and slightly toothed near the apex; margins nearly or quite plane. A singular form, widely different in appearance but without any constant structural differences of importance.

On coarse-grained granite.

KING EDWARD VII LAND: Rockefeller Mts., Mt. Helen Washington, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff 68a.*

BRYACEAE

BRYUM (ARGYROBRYUM) **Siplei**, Bartram, sp. nov.

Type: King Edward VII Land, Rockefeller Mts., Mt. Helen Washington, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff 100.*

Gracile, compacte caespitosum, caespites superne virentes, intus fusco-radiculosi. Caules ad 8 mm. alti, parce ramosi, in axillis superioribus, propagula ovata stipitata foliolis 4–6 ornata gerentes. Folia ovata, acuminata, concava, integra, superne hyalina, inferne chlorophyllosa; costa infra apicem evanida vel excurrente; cellulae superiores elongatae, irregulariter rhomboideae, hyalinae, inferiores rectangulares, chlorophyllosae, margines versus subquadratae.

Slender, compactly tufted plants, silvery green above, pale brown below. Stems sparsely branched, to 8 mm. high, erect, radiculose below, often with ovate, stalked gemmae bearing 4–6 rudimentary leaves in the axils of the upper stem leaves. Leaves rather congested toward the tips of the stems, more scattered below, ovate, concave, gradually acuminate, entire, colorless in the upper half, chlorophyllose below; costa slender and faint, ending below the apex in the lower leaves but often excurrent in the comal leaves; upper hyaline leaf cells irregularly rhomboidal, elongate, lower cells chlorophyllose, rectan-

gular, usually subquadrate toward the margins. Sporophyte unknown.

On coarse-grained granites and highly metamorphosed slates.

Except for the axillary gemmae the differences between this species and the world-wide *Bryum argenteum* Hedw. are slight and of little importance. I take pleasure in naming this plant for Mr. Paul A. Siple, to whom we are indebted for these unusual collections.

KING EDWARD VII LAND: Rockefeller Mts., Mt. Helen Washington, *P. Siple, F. A. Wade, S. Corey & O. D. Stancliff 100*, type.

MARIE BYRD LAND: Edsel Ford Range, Skua Gull Peak, *P. Siple & S. Corey 49* in part.

BRYUM ANTARCTICUM Hook. f. & Wils., Crypt. Bot. Antarct. Voy. Erebus & Terror. 108. *pl. 153. f. 6.* 1845.

Bryum austropolare Cardot, Rev. Bryol. **27**: 45. 1900.

Type: Graham Land, Cockburn Island, 64° S., 57° W., *J. D. Hooker. B. austropolare* was based on Graham Land, Danco Land, Cape Anna Osterrieth, *Racovitza 151b, 151c, 205a,* and Cape Van Beneden, *Racovitza 233b, 234b.*

In small weathered tufts, on highly metamorphosed slates.

As far as this material is concerned it corresponds exactly with the description and illustration of *B. austropolare* Card. but this name is probably, as Mr. Dixon has suggested, a synonym of *B. antarcticum* (Australasian Ant. Exp. 1911–14, Sci. Rept. C. Zoology and Botany **7**: 7. 1918).

MARIE BYRD LAND: Edsel Ford Range, Skua Gull Peak, *P. Siple & S. Corey 49a, 72.*

IV. INDEX

New species, new combinations, and pages on which species are described are printed in **bold face** type; synonyms and page numbers having reference to plates in *italics;* and previously published and accepted names in ordinary type.

Annals
of the
Missouri Botanical Garden

Vol. 25 SEPTEMBER, 1938 No. 3

THE TAXONOMIC IMPORTANCE AND PHYLOGENETIC SIGNIFICANCE OF THE CEPHALODIA OF STEREOCAULON

GEORGE THOMAS JOHNSON

Washington University Fellow in the Henry Shaw School of Botany of Washington University

Introduction

This paper reports the results of a comparative study of the cephalodia of species of *Stereocaulon.* The investigation is concerned primarily with the possible phylogenetic implications and the practical taxonomic value of these structures. Further light will also be thrown on the nature of their relationship to the lichen thallus, since the present evidence does not agree with some of the commonly expressed concepts of this subject. The conclusions are derived from anatomical studies, in which the gross and comparative morphology of the cephalodia are emphasized.

Historical Review

Cephalodia form conspicuous features of the podetia of most species of *Stereocaulon.* These outgrowths are purely vegetative in nature and always enclose one or more algae of a type different from the normal gonidium. Acharius (1803) first used the term to include some lichen tissues that are now

recognized in part as apothecia and in part as lichen parasites. Later (1810) he applied it in the sense of its use to-day, i. e., to the cephalodia of *Peltigera (Peltidea) aphthosa*. Previous to this time cephalodia had not been noted as distinct from other secondary lichen structures although they were included by earlier writers under such general terms as *verrucae* (Weber, 1778) and *tuberculosa* (Hoffmann, 1795). Flörke (1819)[1] first described them in *Stereocaulon* under the name of "corpuscula fungosa." Wallroth (1825) noted that the gonidia of the cephalodia were different in color from those of the thallus, and since Acharius' term had been applied in different ways in the 'Methodus' and in the 'Lichenographia,' he proposed to call these bodies "phymata" to avoid ambiguity. Others have applied different names to them, e. g., *tubercula abortientia* (Sprengel, 1827), *apothecia abortiva* (Schärer, 1833), and *appendices* (Taylor and Hooker, 1844). In this early period only the description of the structures was attempted, and in Th. Fries' 'Commentatio' (1857) and 'Monographia' (1858) the structure and appearance of the cephalodia of each species of *Stereocaulon* treated were described.

The significance of cephalodia from a physiological standpoint is still unknown. Early workers considered them as superfluous structures (see Th. Fries, 1858) or as aborted apothecia (Sprengel, 1827; Schärer, 1833; Taylor and Hooker, 1844). Zukal (see Fünfstück, '26) believed that the blue-green gonidia were especially suited for the storage of water. Th. Fries, in 1858, suggested that they were "monstrous storehouses" from which the lichen could easily draw food, but in 1866 declared that they were pathological structures caused by the presence of a parasitic alga. Before the theory of the dual nature of lichens was advanced (Schwendener, 1867, 1869) cephalodia were held to be lichen organs, and opponents of the dual theory (notably Nylander) always regarded them

[1] Smith ('21), in a footnote, cites part IV of Flörke's work, which according to Lynge (Index specierum et varietatum lichenum quae collectionibus "Lichenes Exsiccati" distributae sunt, Part I, 1915) treats three species of *Stereocaulon*, as appearing in 1815. Lynge gives the date of publication for this fascicle as 1819, which probably is correct.

as such. Forssell (1883, 1884), basing his opinion upon the constant occurrence of cephalodia on definite species, also held this view, considering them adaptations for assimilation in that the blue-green and green algae together could absorb a wider range of the spectrum than one color alone. Elfving ('13, '31) attempted to prove that gonidia have a hyphal origin both in the lichen thallus and in the cephalodium but his conclusions have not been supported by recent work. That the theory of their parasitic nature is generally accepted can be seen by the fact that it was held by Th. Fries (1866), Schwendener (1869), Winter (1877), Babikof (1878), Moreau ('21, '28; M. and Mme., '15, '18, '32), Goebel ('26, '28), Tobler ('32), and Kaule ('32, '34).

The origin and development of the cephalodium have been described in *Peltigera (Peltidea) aphthosa* (Babikof, 1878; M. and Mme. Moreau, '19; Darbishire, '27, '32), *Lobaria (Sticta) linita* (Winter, 1877), *L. (S.) oregana* (Schneider, 1897), *Solorina octospora* (Winter, 1877), *Lobaria (Ricasolia) herbaceae* and *L. (R.) amplissima* (Moreau, '21). Forssell (1883, 1884) and Kaule ('32, '34) have made anatomical studies of the cephalodia in a large number of genera and species.

The taxonomic value of the cephalodium was first suggested by Nylander (1860), who distinguished three types of gonidia in the structure: (1) stratum gonimon scytonemoideum, (2) stratum gonimon sirosiphonoideum, and (3) stratum gonimon e modulis gonimicis formatum; and adopted these different types as the distinguishing characteristics of different species. Since that time the type of gonidium has been used to differentiate species in the genus *Stereocaulon*, even though Th. Fries (1866) found all three in the same cephalodium. Riddle ('10) gave statistical data to support his opinion that the kind of alga is a good distinguishing character between certain species. Magnusson ('26) stated that the cephalodia have great taxonomic value, suggested that the species with *Nostoc*-algae are more closely related to each other than to species with *Scytonema*-algae, and recommended the investigation of these structures from various points of view. Frey ('33) neglected such characters in his treatment of the genus, and stated

that until pure culture methods demonstrate whether or not the choice of cephalodial gonidia is specifically parallel with that of normal gonidia we must be content with gross morphology in our bounding of species. A critical survey of cephalodia, based upon species of *Stereocaulon,* has not previously been made.

Materials and Methods

The herbarium of the Missouri Botanical Garden and the private herbarium of Dr. C. W. Dodge, supplemented by minor collections from other sources, furnished ample material for the study of species of *Stereocaulon* from most regions. The value of the cephalodia in taxonomy and phylogeny may be observed: (1) by the correlation of their gross and microscopic morphology with other structures of the lichen; and (2) by a comparative study of their origin and development. Accordingly, free-hand sections were made of the cephalodia and of other parts of the various species, and an attempt was made to correlate the different characters of these structures. In addition, complete developmental series of each type of cephalodium were embedded in paraffin, sectioned at 10 μ, stained in Heidenhain's iron-alum haemotoxylin, and mounted in balsam. Slides prepared in these ways were considered sufficient to test possible hypotheses.

Th. Fries (1857, 1858, 1866) had recognized two general types of cephalodia in this genus: one typified by these structures as they appear in *Stereocaulon paschale* and *S. denudatum,* the other as they appear in *S. ramulosum.* In addition to these two groups, Dodge ('29) recognized a third major division in his key, typified by the appearance of these bodies in *S. botryophorum.* These divisions, based upon the gross morphology of the cephalodium, seem to be comparatively stable and have been accepted as natural units in this paper. Then the present paper is really an attempt to formulate in some measure the extent to which the above groups express natural relationships.

The practical taxonomic value of a structure is its constant occurrence. Of three hundred specimens of *Stereocaulon*

taken at random from the herbarium, 87 per cent possessed an abundance of cephalodia, whereas only 68 per cent were fertile. Thus cephalodial characters, compared to apothecial characters, are more valuable if this fact alone is considered. If the validity of these clues to the identity of the 32 per cent sterile material can be tested, this study will be of practical value, for the correct determination of such material will undoubtedly enrich the distribution records of many species.

Criteria for Phylogenetic Sequence in Stereocaulon

In a study of phylogenetic relationships it is necessary to have some idea as to what characters are primitive and what are advanced within this genus. To evaluate these criteria it seems best to formulate the general trend of evolution within the family Cladoniaceae. This family differs so markedly in thalline development from other members of the Cyclocarpineae, i. e., in that it possesses a primary thallus from which a podetium or secondary thallus develops, that it is generally considered to be monophyletic in origin (Smith, '21). The primary thallus may be crustose, squamulose, or foliose, and the secondary thallus which arises from it is always fruticose. The podetium is terminated by apothecia and may be simple or branched. The spores are hyaline and range from one to many-celled. Cephalodia may or may not be present. The apothecium in this family is biatorine or lecideine, the most characteristic difference from other families being in the degree of development of the thallus described above. Glancing at the characters enumerated one can easily see that the phylogenetic starting point of the Cladoniaceae is undoubtedly to be found in a simple lichen possessing a crustose thallus, hyaline, one-celled spores, and a biatorine or lecideine apothecium. The apothecial stalk, by elongation (Reinke, 1894–1896; Wainio, 1897), secured good light conditions for the fruit and facilitated the distribution of spores (Smith, '21), resulting in a lichen bearing a single terminal apothecium on a stalk, similar to *Baeomyces*. Later the podetium increased in size and branching due to the assumption of vegetative functions;

in the genera in which vegetative development of the secondary thallus was very great the primary thallus tended to disappear. In some genera in which the podetial development is not so pronounced the common evolutionary trend from crustose to foliose primary thallus can be traced.

The genera of the Cladoniaceae might be arranged in a scheme such as is shown in fig. 1. In the left-hand branch one can trace the advance from a crustose to a foliose primary thallus (though it often disappears in some species of *Cladonia),* an increase in spore septation from *Gymnoderma* to *Heteromyces,* but remaining one-celled in the branch leading to *Cladonia.* The center branch has advanced primarily in spore septation. Some species of *Baeomyces* have septate spores; *Thysanothecium* has 1–2-celled spores, *Glossodium* 2–4, and one species of *Gomphillus* 100. At the top of this series, the primary thallus, although retaining its crustose form, has degenerated to a homoiomerous condition. The right-hand branch differs from the other two in the possession of cephalodia, usually occurring on the primary thallus of *Pilophoron* (which is primitive in having one-celled spores and a podetium that is seldom branched) and on the secondary thallus of *Argopsis* and *Stereocaulon.* In this branch an increase in the septation of the spores can also be traced *(Argopsis* forming a side branch with muriform spores). Degeneration of the primary thallus is likewise evident, for in most species of *Stereocaulon* and in *Argopsis* this structure is evanescent.

From a glance at this scheme of evolution within the Cladoniaceae it is fairly evident that the following may be considered as trends to advancement in relation to *Stereocaulon:* (1) increase in the septation and consequently in the length of the spore, (2) development of a large, branching, fruticose podetium, (3) degeneration of the primary thallus, and (4) development of cephalodia. To prove the taxonomic value of cephalodia it is now necessary to show that cephalodial characters are correlated with the tendencies noted above as well as with other characters useful in the determination of species of this genus.

To what extent may the presence of cephalodia be considered a derived character? If cephalodia are due to the presence of parasitic algae, as is ordinarily assumed, they can hardly be so considered—although the extent of adaptation against the disease could easily be—but if it is believed that

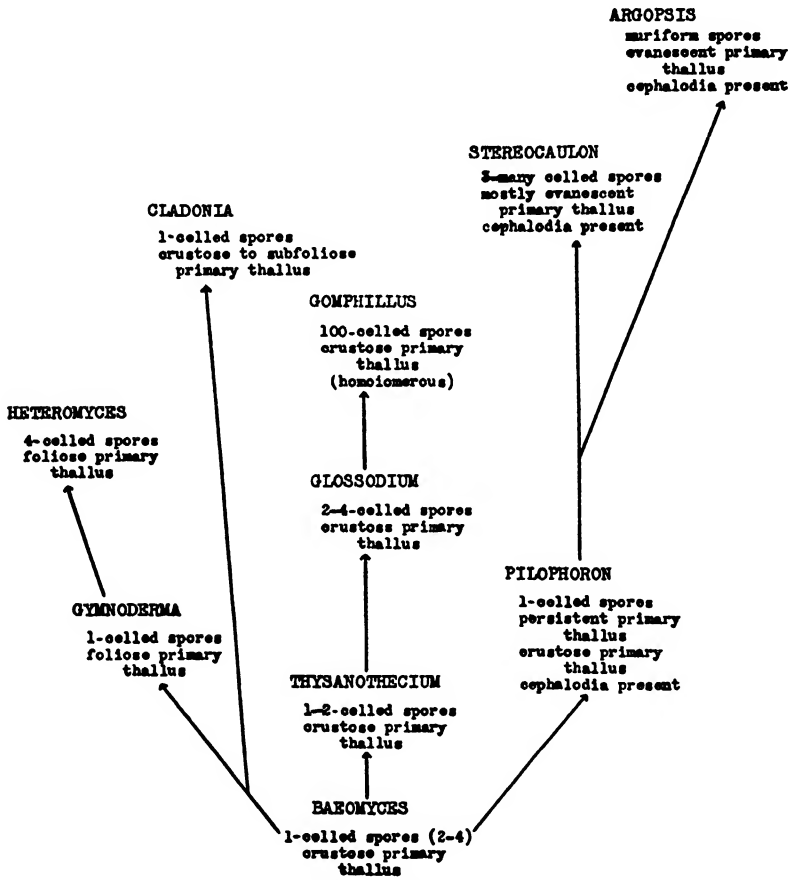


Fig. 1. A diagrammatical presentation of the phylogenetic connections within the family Cladoniaceae suggested in the text.

the blue-green algae are also in symbiotic relationship with the fungal constituent of the lichen, considerable phylogenetic significance must be associated with their presence.

Lichens are polyphyletic in regard to fungal and algal components, and it is commonly assumed that when similar algae

are held by different fungi they are of independent origin, whereas when different algae are held by the same fungus they are of common origin. Yet although the same fungus apparently may utilize various algae, the presence of two algae in the same thallus is rather rare, being common only in the few species producing cephalodia and perhaps in certain species of *Solorina* (the latter case depending upon whether or not the blue-green algal mass in such species as *S. crocea* is considered a cephalodium; see Hue, '11). Thus several systems (Reinke, 1894, 1895, 1896; Zahlbruckner, '26; Smith, '21) recognize chlorophyll and cyanophil groups as being relatively distinct.

In considering antiquity of symbionts it is believed that lichens containing green algae are the older group whereas the cyanophils are of relatively recent origin (Forssell, 1885; Hue, '11; Smith, '21). From the standpoint of theory it is reasonable to assume that the fungus of the lichen, first adapted to symbiosis with green algae, later adapted itself to an additional symbiotic union with blue-green algae. Although it is improbable that all lichens with cephalodia are closely related, the tendency to form these structures usually persists through an entire family or tribe and these families or tribes are usually recognized as being relatively high in their respective series.

Cephalodia have not yet been reported in the Pyrenocarpeae and Graphidineae. In the Coniocarpineae they occur only in *Sphaerophorus,* the terminal genus of that group. The cephalodia-bearing plants of the Cyclocarpineae belong for the greater part to the Stictaceae, Peltigeraceae, and Pannariaceae (the three most highly developed families of the Phycolichens) and to the *Pilophoron, Stereocaulon,* and *Argopsis* branch of the Cladoniaceae (a family which terminates an evolutionary branch in the Archilichens). It seems significant that all genera of foliose and fruticose lichens producing cephalodia are commonly recognized as advanced. There are, however, some relatively primitive crustose genera, e. g., *Lecidea* and *Lecanora,* which contain a few cephalodia-bearing species. The antiquity of these crustose genera and the large number of species within the genera would make it quite possible for a

few species to adapt themselves to the production of cephalodia (see Kaule, '32). The reason for this occurrence primarily in advanced groups, thus indicating an advanced character, is not understood. The real physiological significance of the cephalodium is not known, and few theories to account for its presence have been advanced. The prevalent opinion is that such structures are pathological growths which injure the host plant (see page 731). This does not seem to be the logical explanation, however, at least as far as their occurrence in the genus *Stereocaulon* is concerned. The question will be considered in greater detail later. It has been suggested, and it is indeed likely, that these bodies aid in nitrogen fixation (Cengia Sambo, '23, '26, '31; Darbishire, '24, '27). If this be true the degree of advancement can readily be appreciated, the fungus being specialized to the extent that it can utilize one alga to manufacture its usual food and an alga of an entirely different nature for its nitrogenous material.

From the evidence so far adduced one might be justified theoretically in holding that the species of *Stereocaulon* without cephalodia are more primitive than those that possess them. Yet one should not depend upon one structure for the state of advancement that a group of individuals may have attained, and particularly so when that character is a vegetative one. Since an acceptable system is always based upon a combination of characters, we may here consider the association of the types of cephalodia and the absence of cephalodia with other vegetative and with sexual characters.

Types of Cephalodia

Nylander (1876), Forssell (1883, 1884), and Schneider (1897) have classified cephalodia into several subdivisions. The cephalodia of *Stereocaulon* fall into the epigena group of Forssell's *cephalodia vera,* into Nylander's *cephalodia epigena,* and into Schneider's ectotrophic group. The cephalodia of this genus have a varied gross morphology, and on this basis may be divided into three groups as suggested by Dodge ('29). Merely for the sake of convenience, these may be desig-

nated as spherical, botryose, and scrobiculate, characterized as follows:

Spherical: Cephalodia sessile or nearly so, at times partly immersed, often inconspicuous, hemispherical to subspherical, small, seldom over 1 mm. in diameter, the larger ones appearing in aggregates or irregularly rounded, gray to brown masses (pl. 66, figs. 1 and 2).

Botryose: Cephalodia often stalked at maturity, similar in shape to bunches of grapes, concolorous with the podetium, cinereous to glaucescent, usually rather large, 2–4 mm. in diameter (pl. 66, figs. 3 and 4).

Scrobiculate: Cephalodia usually stalked at maturity, globular but more or less clavate, pitted and furrowed with fine convolutions, concolorous with the podetium, whitish to ashy, often large and numerous, 1–7 mm. in diameter (pl. 66, figs. 5 and 6).

These groups are apparently very distinct. In mature material with an abundance of cephalodia it is almost impossible to make a mistake in determining the relationship. In exceptionally young material, however, both the botryose and scrobiculate cephalodia appear as small spherical bodies, and occasionally there is a conglomeration of spherical cephalodia (usually formed by the growing together of several whose origin was near a common point) which sometimes approaches the botryose condition, although never completely so. Few of these exceptional cases occur, and if there are enough cephalodia on the material examined (as is normally the case) so that the range of variation can be easily seen, the groups as a whole are very uniform.

The Origin and Development of Cephalodia

Young podetia of *Stereocaulon* possess a cortex and an algal layer in addition to the central cylinder. In mature specimens, however, a cortex is present only around the phyllocladia and cephalodia (Schwendener, 1860; M. and Mme. Moreau, '32) which occur in scattered spots. Evidently these layers have burst due to growth of the central cylinder, and algae other

than those in the two organs mentioned above lie in small groups here and there in a loose tissue around the axis of the lichen (Kaule, '32). The cephalodia arise on this relatively naked, secondary axis—which in longitudinal section shows two fairly well-defined layers: an inner axis composed of usually parallel, thin hyphae, and an outer layer of thicker, more gelatinous hyphae, often interwoven. Certain blue-green algae fall on this outer layer and initiate cephalodia.

The account below is based primarily upon complete developmental series of cephalodia of the following species:

Spherical group: *Stereocaulon paschale* and *S. tomentosum.*

Botryose group: *Stereocaulon exutum* and *S. japonicum.*

Scrobiculate group: *Stereocaulon ramulosum* and *S. nesaeum.*

Less extensive series were available in the nature of free-hand sections of the cephalodia of several other species.

Spherical: The blue-green algal clusters on the podetium vary from microscopic to rather large-sized (a colony of *Nostoc* 4 mm. in diameter was found on a moistened specimen of *S. tomentosum).* The presence of certain of these algae starts cephalodial development; the hyphae of the outer layer of the podetium elongate considerably and surround the algal cells (pl. 67, fig. 1). Hyphal branches grow into the interior from all sides of the enclosing wall thus formed and penetrate between the cells or filaments of the alga (pl. 67, fig. 2). Usually penetration has taken place to the extent that the normal appearance of the host alga is obliterated and it is now seen as small single-celled units embedded in a spherical mass of interwoven hyphae (pl. 67, figs. 2 and 3). The algae begin to divide and secrete a gelatinous sheath which is closely surrounded and sometimes penetrated by the fungus (pl. 67, fig. 5). The wall of the cephalodium and the outer layer of the podetium dissolve at the point of contact and the hyphae surrounding the blue-green algae are thus brought in closer relationship with the interior of the lichen. By further growth these hyphae become interwoven with those of the central cylinder of the

podetium, often anastomosing and fusing with them. This connection with the podetial axis is very distinct but a long stipe is not formed by cephalodia of this group. In younger stages the close adherence of the fungal hyphae to the gelatinous sheath surrounding the algae gives the appearance of a number of "capsules" in the interior of the cephalodium in which the algae lie (pl. 67, fig. 5). This stage persists for a short time only; probably the sheath becomes less viscous in mature cephalodia, for it then appears more diffuse and the fungal elements form hyphal plates so that a chamber-like division into several portions results (pl. 67, figs. 4, 6, and 7). The algae are kept in intimate contact with the central cylinder of the podetium at all times by hyphae running from chamber to chamber and finally to the central axis of the lichen. In the earlier stages the algae of the cephalodia would usually be identified as *Gloeocapsa,* but by the time the chambers have differentiated the colonies have assumed their typical form in cephalodia with *Stigonema, Scytonema,* or *Nostoc.* The hyphal plates are of varying thicknesses, and near their point of origin, i. e., near the wall of the cephalodium, often pass into a sort of pseudoparenchymatous zone. Farther toward the outside is the wall, composed of thicker, peripheral hyphae (pl. 67, figs. 5, 6, 7, and 8). The wall is comparatively thin and never is as distinct as in the scrobiculate type (e. g. in *S. ramulosum,* pl. 68, fig. 8). A conspicuous stalk is only rarely formed, although occasionally the hyphae running from the clumps of algae to the central cylinder of the podetium are quite well developed and so resemble one. The shape of the cephalodium is primarily dependent upon that of the algal mass about which it was built. If the mass were small the cephalodium would tend to be spherical or subspherical, but if it were extended, flattened, or linear that shape could also be assumed.

After the cephalodium has spent some time in vegetative growth a deterioration of its algae can be observed. This is first noted merely as a loss of color but later is clearly evident as an alteration in the structure of the algal cells. The cell content shrinks, and cavities can be seen within the gelatinous

sheath. Later the sheath itself becomes wrinkled and lobed abnormally. Even in young stages a large number of dead cells are found; in older stages only empty membranes are visible. The algae often are totally absorbed by the lichen, and with the death of the algae the walls of the hyphae in the cephalodium thicken noticeably. These hyphae seem to be without further function.

Summarizing we can say that the cephalodia of this group are relatively primitive because they have indefinite shape and a loosely arranged wall, and because they are sessile, rarely producing a well-defined stipe.

Botryose: The cephalodial primordium of the botryose group is very similar to that of the spherical group. A single cell, a small filament or a colony of blue-green algae coming in contact with the podetium is immediately surrounded by hyphae from the outer layer. The algal cells then come to lie more or less at random in a spherical mass, the hyphae merely being interwoven (pl. 67, fig. 9). Hyphal branches grow from this surrounding wall, and no matter what alga may be present at this stage its cells are independent units separated by the fungus (pl. 67, fig. 10). The algae continue to divide, and a gelatinous sheath is formed around the *Gloeocapsa* colonies or the *Nostoc* and *Stigonema* filaments (pl. 67, figs. 11 and 12). As in *Stereocaulon paschale* and *S. tomentosum,* this sheath is closely surrounded by the hyphae of the fungal component. At this time the outer layer of the podetium and the wall of the cephalodium coalesce; the hyphae of the inner part of the cephalodium grow through and become attached to the central cylinder of the podetium. Thus an intimate union is formed between the capsulated algal groups and the central cylinder of the lichen at an early stage. The wall of the cephalodium differs markedly from that of the scrobiculate type in that it is looser, much thinner, and is composed of interwoven rather than of periclinal hyphae (pl. 67, fig. 14). This interwoven wall sometimes appears to be intermediate between the peripheral orientation of the hyphae common in the spherical group and the periclinal orientation in the scrobiculate type. The

walls of the cephalodia of the two former groups are undoubtedly less highly specialized than those of the latter. As in the case previously described, the gelatinous sheath of the algae becomes less evident with age and diffuses out. The surrounding hyphae then form hyphal plates which divide the cephalodium and its algal content by several partitions (pl. 67, fig. 13). The method of lobe formation appears to vary slightly. In some young cephalodia the algae come to lie near the outer wall. In this case neither complete lobes nor complete hyphal plates are formed, but the cephalodium rounds out conforming to the spatial limitations imposed by the partially formed plates. Thus, although the lobes are rather distinct they are not chambered units in the cephalodium. The algal layer follows, in general, the contour of the lobes near the outer wall. The other type of lobing is apparently the normal one. The hyphal plates surrounding the algal colonies, as described above, grow so as to enclose them almost completely before making their connection with the central cylinder of the podetium. Growth and division of the algae inside the chambers thus formed expand them into the lobes so visible externally (pl. 67, fig. 15). The number and size of lobes formed are not definite, and there is no variation in the gross morphology of the two types of botryose cephalodia described. The arrangement of the algae in the cephalodium is quite varied but often seems to be correlated with the source of light. In old cephalodia the stages previously recorded in the deterioration of the algae are very numerous.

From the standpoint of anatomical structure this type of cephalodium is seen to have advanced from the condition found in the spherical group in that it has acquired a more definite form, a more highly developed conducting system, a wall often composed of interwoven rather than of peripheral hyphae, and usually a well-defined stipe.

Scrobiculate: A cell, filament, or colony of *Gloeocapsa, Nostoc, Stigonema, Scytonema,* and possibly related genera, may initiate the cephalodium in this group (pl. 68, fig. 1). Most of these have been found within a single cephalodium of a plant.

The type of alga does not alter the gross morphology of the structure; and the microscopic structure is only slightly different with different algae. The primordium is surrounded by hyphae which arise from the outer layer of the podetium and form a spherical mass, similar to the same stage in both the spherical and botryose groups (pl. 68, fig. 3). Hyphal branches grow inward from this enclosing layer and penetrate between the cells of the alga. By this time the alga has usually divided a few times, and if a filamentous or colonial form were present it has now been separated so that its cells appear as individual organisms (pl. 68, fig. 2). The algal genus cannot be distinguished at this stage. These cells lie apparently at random in a dense spherical mass of hyphae. The mass is uniformly dense and no outer wall has been formed.

The algae continue to divide and each cell that is now separate seems to give rise either to a small colony or a filament which becomes surrounded by a gelified sheath. The hyphae of the fungus form a firm layer closely adnate to each sheath (pl. 68, figs. 6 and 10) from which hyphal connections can be traced back into the central cylinder of the podetium in median sections (pl. 68, figs. 5 and 7). After this, the hyphae divide the algae into several masses, forming plates around the various clusters. Simultaneously, several hollow spaces are formed (especially noticeable in cephalodia containing *Nostoc* or *Gloeocapsa)* through which interlacing hyphae run from clump to clump and then into the podetium (pl. 68, fig. 4). The wall of the cephalodium has been forming during this time, and is now about one-half of its probable thickness at maturity, consisting of thick, more or less periclinal hyphae but interwoven enough to produce a firm, unbroken wall. Long search has not revealed an opening in the outer wall of the cephalodium. The entire structure is still spherical or ovoid.

Later convolutions form and the structure becomes more or less pitted (pl. 66, figs. 5 and 6). This is apparently due to the looseness of the conducting hyphae and the arrangement of the algal masses in a favorable position with reference to the source of light. At this stage a visible stalk is usually

formed, rudiments of which can be seen microscopically in very early stages. The stalk consists of two layers: the cephalodial wall, and the core of conducting hyphae. The core sometimes extends as much as one-third of the diameter into the cephalodium and may or may not form before lobing takes place (pl. 68, figs. 4 and 5). In median longitudinal sections its primordia may be seen at the time that the definite gelatinous sheath is first formed. The cephalodial wall has increased in thickness, presumably simply by elongation of the periclinal hyphae (pl. 68, figs. 8 and 11). It is composed of a closely packed tissue of hyphae and thus is quite different from the wall of the podetium which is of comparatively loosely interwoven hyphae. The mature cephalodium consists of this compact wall with the outline of a stalked, irregular pocket filled with a tissue of loosely interwoven filaments and hyphal plates intimately associated with blue-green algal masses (pl. 68, fig. 11). In cephalodia with *Nostoc* and *Gloeocapsa* the algae seem to be scattered in groups, but in those with *Stigonema* and *Scytonema* they occupy almost the entire cavity. The destruction of the algae (pl. 68, figs. 9, 12, and 13), previously mentioned in old cephalodia, with a corresponding thickening of the cephalodial hyphae after their death, is very evident.

Several times young cephalodia forming on the wall of fully developed cephalodia are found (pl. 68, fig. 2). The mode of origin and subsequent development are the same as though they had occurred on the podetium. In very young stages connecting hyphae are sent through the wall of the older cephalodium and make contact with its conducting hyphae; at the point of contact the cephalodial wall is destroyed. This observation easily explains how two kinds of algae might be found in the same cephalodium.

Anatomically considered, the scrobiculate group contains the most advanced cephalodial type. The specialized shape of the cephalodium, the highly developed conducting system, and well-defined stipe, together with a derived wall structure, raise it far above the other groups, for none of them possess all of these characters.

Characters Associated with the Types of Cephalodia

The genus *Stereocaulon* has great variability in the characteristics of its members, somewhat similar to that found in the closely related genus *Cladonia.* Thus specific relationships must be settled upon combinations of characters, and these characters often vary considerably within a species. Spore sizes have minor variations among species in most groupings of this genus but on the whole are so uniform as to be without value in specific diagnosis (Riddle, '10). In general, spore characters are the most conservative (note emphasis of Watson, '29, and Gilbert, '27, on them), and since the elongation and increasing septation of the spores cannot be shown between species they would be expected to show within the family (see p. 734). From table I it is indeed quite apparent that there is a gradual elongation of the spores and an increasing septation of the same structures within the groups based on cephalodia, in the following order:

Cephalodia lacking: The apothecia also are often lacking. Only one species, *Stereocaulon pygmaeum* (specimens not seen by the author), which, according to Dodge ('29), belongs in this section, has been reported with spores. Dodge gives the spores of this species as 13–15 μ in length, 3-septate.

Spherical: spores 20–39 μ in length, 3–7-septate.

Botryose: spores 24–100 μ in length, 3–16-septate.

Scrobiculate: spores 35–200 μ in length, 3–29-septate.

It is also seen, as would be expected, that other associated fruiting characters (often used in distinguishing species in this genus), such as length of asci, height of hymenium, and thickness of hypothecium, are correlated with the length and septation of the spores. Furthermore, it is significant that the evidence obtained from this comparison agrees in every detail with that derived from anatomical studies of the origin and development of cephalodia in that the groups may be arranged as follows, each one in sequence indicating a more advanced condition: spherical, botryose, scrobiculate.

Advanced species of *Stereocaulon* have been predicted to

TABLE I

CORRELATION OF CERTAIN APOTHECIAL CHARACTERS WITH THE CEPHALODIAL TYPES[1]

Cephalodia	Species	Spore length in μ	Spore septa	Thickness of hypo-thecium in μ	Height of hy-menium in μ	Length of ascus in μ
Lacking	*albicans*	Apothecium lacking				
	arbuscula					
	congestum					
	gracilescens					
	nanum					
Spherical	*condensatum*	25–35	3	30–50	40–50	35–45
	pileatum	20–30	3	20–30	50–60	43–55
	alpinum	25–35	3	35–40	45–60	35–50
	coralloides	20–35	3–5	35–50	50–60	40–45
	cornutum	28–32	3	40–65	46–60	42–50
	denudatum	22–38	3–5	25–35	50–70	40–50
	glareosum	25–37	3	25–40	45–55	48–50
	nabewaziense	30–35	3–4	45–60	45–60	35–52
	paschale	28–39	3	45–60	50–65	35–50
	rivulorum	30–35	3	35–50	60–70	55–60
	sphaerophoroides	35–38	3	45–60	45–60	43–50
	tomentosum	25–35	3–7	45–60	45–60	35–45
	Wrightii	Apothecia not seen				
Botryose	*botryophorum**[2]	75	11	–	–	–
	corticatulum	25–40	3	60–80	60–95	50–75
	curtatum	36–40	3–7	55–70	70–95	65–85
	exutum	30–48	3–5	80–88	80–105	70–85
	foliolosum	94–100	14–16	74–95	120–140	105–120
	japonicum	25–48	3–5	45–75	72–96	50–85
	nigrum	40–50	3–7	45–80	70–95	60–75
	octomerellum	34–55	3–7	60–85	75–98	70–85
	prostratum	24–30	3	65–75	80–105	50–78
	uvuliferum	25–35	3	65–75	65–82	52–70
Scrobiculate	*chlorocarpoides*	75–100	5–9	65–80	135–190	110–160
	*lecanoreum**	72–80	5–7	–	–	–
	macrocarpum	40–70	3–5	95–110	105–140	70–90
	*macrocephalum**	200	19–29	–	–	–
	mixtum	36–75	3–5	50–90	65–110	60–90
	nesaeum	70–120	5–12	70–90	120–150	105–135
	pilophoroides	50–65	5–9	80–110	95–140	80–110
	piluliferum	60–110	5–15	80–105	120–200	90–160
	proximum	40–70	3–5	45–85	75–110	60–90
	ramulosum	35–95	3–5	50–94	70–120	50–110
	*sinense**	132–155	29	–	180–200	176–190
	*sorediiferum**	100–110	7–9	–	150	88–115
	strictum	80–90	3–7	65–85	130–170	105–120

[1] Values recorded in tables I and II do not apply to type or authentic material in all cases, but represent the range of the available herbarium material determined to the species listed. Since in many cases only a few specimens were present it might be expected that the average and even extreme figures would differ slightly had additional material been available.

[2] Specimens of species marked with an asterisk were not seen. Figures cited here are taken from the original type descriptions or from subsequent examination of the types and are included to give a more complete conception of the extremes of certain groups.

have evanescent primary thalli. This is true of all the species considered with botryose and scrobiculate cephalodia, which on the basis of certain apothecial characters, notably spore size and septation, have been indicated as being most advanced. Two species in the section with spherical cephalodia, i. e., *Stereocaulon condensatum* and *S. pileatum,* have persistent primary thalli. The presence of spherical cephalodia, a small podetium, short, few-septate spores, and a persistent primary thallus have all been indicated as being primitive characters. Thus it seems that the two species mentioned fulfill all of the requirements of a primitive state, and on that basis must be designated as the group that is in all probability most similar to the ancestors of the representatives of *Stereocaulon* existing to-day. That group of species lacking cephalodia may have either a persistent or evanescent primary thallus, indicating a primitive condition, as does the absence of cephalodia itself (since these are derived characters). Perhaps this section could be considered even more primitive than the group with spherical cephalodia. Yet whenever such a state is indicated it is necessary to inquire whether the given combination of characters indicates a truly primitive or merely a reduced condition. Since the probable ancestors of *Stereocaulon,* forms similar to the genus *Pilophoron* (fig. 1), possessed cephalodia, at least on the primary thallus, it seems more logical to believe that the most primitive species of *Stereocaulon* should also have them. Thus the group under consideration can reasonably be assumed to have undergone a reduction from the primitive state designated above, the reduction being evident in the disappearance of cephalodia and often of apothecia, as well as in other correlated characters which will be mentioned below, tendencies logically connected with the arctic-alpine environment in which it occurs.

It was also considered that a small, erect, secondary thallus bearing a single terminal apothecium would represent a primitive condition, while a large, vigorously branching podetium bearing numerous apothecia would be more advanced. To a certain extent table II shows the variation predicted from family analysis, the extent of branching being indicated by the

number of main branches and the apothecial index (a term used to refer to the number of apothecia terminating the main branches and branchlets of the podetium—see note 4, table

TABLE II

CORRELATION OF CERTAIN VEGETATIVE CHARACTERS WITH THE CEPHALODIAL TYPES[1]

Cephalodia	Species	Size in cm.	Branching[3]	Color	Apoth. index[4]	Predominant type of phyllocladium
Lacking	*albicans*	.6–1.4	0–1	white		granular
	arbuscula	1–2	0–2	grayish		granular
	congestum	1.5–2	0–2	white		verruciform
	gracilescens	.5–1.5	0–1	white		granular
	nanum	.2–.6	0–3	whitish		granular
Spherical	*condensatum*	.3–1.2	0–1	gray–dark	0–2	granular–verruciform
	pileatum	.5–1.0	0–1	light–dark	0–1	granular to elongated
	alpinum	1–3	1–3	gray–dark	3–15	verruciform
	coralloides	2–4	3–5	white–gray	3–20	coralline
	cornutum	5–9	0–1	white–gray	0–2	coralline–flattened
	denudatum	1–7	0–3	gray–dark	0–6	flattened–umbilicate
	glareosum	1.5–2.5	2–4	grayish	3–8	cylindrical–terete
	nabewaziense	2.5–3	2–4	gray–dark	3–8	flattened–squamiform
	paschale	2–9	2–5	light–gray	0–14	palmate–digitate
	rivulorum	1–2	1–3	grayish	0–15	verruciform–umbilicate
	sphaerophoroides	3–5	2–7	gray	0–10	verruciform–elongate
	tomentosum	3–10	2–4	gray–dark	0–6	squamulose
	Wrightii	3–5	0–2	grayish	–	absent
Botryose	*botryophorum**[2]	2–4	–	–	–	coralline
	corticatulum	.8–2.0	0–3	dark	4–8	granular–subcoralline
	curtatum	1–2	0–3	gray–dark	1–6	papilliform–coralline
	exutum	3–5.5	2–4	brown–dark	4–10	coralline
	foliolosum	2–4	3–4	light	0–3	coralline
	japonicum	1.2–3.5	0–4	dark	1–8	coralline–verruciform
	nigrum	2–4	0–4	dark–black	2–7	coralline
	octomerellum	.4–1.2	0–2	dark	1–3	coralline–subcoralline
	prostratum	.4–.9	0–1	dark–gray	1–2	subcoralline–coralline
	uvuliferum	2.5–5	1–4	gray–dark	2–10	coralline–terete

TABLE II—Continued

Cephalodia	Species	Size in cm.	Branch-ing[3]	Color	Apoth. index[4]	Predominant type of phyllocladium
	chlorocarpoides	5–9	5–7	whitish	7–22	coralline–terete
	*lecanoreum**	5–7.5	–	whitish	–	coralline
	macrocarpum	6–12	5–6	whitish	20–44	coralline
	*macrocephalum**	1.5–4	–	–	–	coralline
	mixtum	4–8	6–10	whitish	17–48	coralline–terete
Scrobiculate	*nesaeum*	4–7	4–7	light	15–50	coralline–terete
	pilophoroides	6–12	3–7	whitish	15–52	coralline
	piluliferum	1.5–3.5	2–5	light	5–15	coralline–terete
	proximum	6–9	4–10	whitish	7–38	coralline–terete
	ramulosum	3–10	3–10	whitish	5–48	coralline–terete
	*sinense**	2–4	–	–	–	coralline
	*sorediiferum**	2–4	–	–	–	coralline
	strictum	4–7	4–6	light	4–11	coralline–terete

[1] See footnote 1, table I.
[2] See footnote 2, table I.
[3] The values listed indicate the number of main branches of mature podetia.
[4] Apothecial index is the term used to refer to the number of apothecia terminating the branchlets of a podetium. It is a measure of the extent of main branching rather than of the fineness of the subdivisions or of the number of apothecia produced. The lateral apothecia of the species that produce them are not included here and in many cases (especially in species with spherical cephalodia) it is difficult to distinguish a sub-lateral from a terminal apothecium. The values then are more or less relative but do indicate the tendencies present.

II). As can be seen, the section with scrobiculate cephalodia is by far the most advanced, having a size range of 1.5–12 cm. and an apothecial index of 5–52. The botryose and spherical (exclusive of the two species designated as primitive) groups occupy the reverse order expected, having a size range of 0.4–5.5 and 1–10 cm. respectively, and these are correlated with apothecial indices of 0–10 and 0–20. The number of apothecia produced on the podetium also agrees with these indications. The spherical group as limited here often shows almost as many fruiting bodies as the scrobiculate type, contrasted with the relatively few produced by the botryose section. That the latter section has the smaller podetium and less apothecia is perhaps due to the fact that the cephalodia, though undoubtedly more specialized, are fewer and that the apothecia are often unusually large. The differences, however, are great enough to indicate a more or less parallel development of the species with botryose and the advanced species with spherical

cephalodia rather than to harmonize with the hypothesis that one of these groups might have arisen from the other.

The nature of the phyllocladium is also considered of value in determining species. Each species has a typical form which, although quite variable and developing many different stages, gives a distinct appearance to the plant (Riddle, '10; Magnusson, '26). Tabulation of these organs (table II) for the various groups of cephalodia recognized shows that a particular type of phyllocladium is associated with a particular group. A reduced, granular structure is characteristic of the species without cephalodia; the species with spherical cephalodia show a transition from the granular to more highly developed (though quite varied) forms; and the botryose and scrobiculate groups usually possess well-developed, coralline phyllocladia that are often branched. Moreover, since the color and size also agree with the proposed grouping, the entire habit of the plant, considered important in distinguishing species of the genus, may be said to be correlated with the cephalodial types recognized in this paper.

The brown hypothecium, upon which the section *Phaeobasis* (Wainio, '15) was founded, appears sporadically among the divisions noted here. Although this character is at times used to distinguish species groups it evidently is not associated with any other character considered as having phylogenetic value. This same conclusion has already been reached by Redinger ('36) who points out such great divergencies between species of *Stereocaulon* with a dark hypothecium that on this basis alone they cannot be held closely related. Thus the section *Phaeobasis* should not be taken as an expression of natural relationship.

Specificity of Cephalodial Gonidia

It is interesting to note that the cephalodial gonidia of *Stereocaulon* are always blue-green and not green algae like the normal gonidium. Also of possible significance is the fact that the ability to form such structures is generically defined. A dispute, however, has arisen as to whether there is any vari-

ability in the algae enclosed in these organs. Many Chlorophyceae and Myxophyceae occur as epiphytes on the podetium, especially of the tomentose species, whereas only a few genera have been identified in cephalodia. Nylander (1860) described several species of *Stereocaulon* based upon the nature of the cephalodial contents. Th. Fries (1866) found all of Nylander's types in a single cephalodium and consequently did not accept the latter's species, further postulating (although stating that he was not certain) that these types were three different stages in the development of a parasitic algal genus *(Stigonema = Sirosiphon)*. Schwendener (1869) held that the algae did not change their appearance during development but stated that the three kinds of gonidia were three different algae *(Stigonema, Scytonema,* and *Nostoc)*. Although Th. Fries found these types in a single cephalodium in 1866, leading lichen taxonomists have either neglected or refused to recognize his work, for they accepted species based solely on the kind of algae present (Nylander, 1888; Hue, 1898; Zahlbruckner, '27; Dodge, '29). Riddle ('10) and Magnusson ('26) have stated that the algal content of the cephalodium is a good specific character although Riddle recorded one specimen with two kinds of algae, while Magnusson found both *Nostoc* and *Stigonema* in the cephalodia of *Stereocaulon fastigiatum* and *S. paschale.* In *S. ramulosum* Schwendener (1869) and Forssell (1883, 1884) recorded *Nostoc* and *Stigonema;* Bornet (1873) reported *Scytonema* and *Lyngbya.* Frey ('33) found *Nostoc* and *Stigonema* in *Stereocaulon paschale, S. grande, S. denudatum,* and *S. botryosum.*

Certain facts obtained from the study of the development of the cephalodium should be emphasized here. In the early stages it is impossible to distinguish the genus of algae present. In some of these stages (especially in species of the spherical group) *Stigonema* and *Scytonema* (and sometimes *Nostoc)* contained in cephalodia would be identified as *Gloeocapsa.* Forssell (1883, note, p. 14) recorded transitions between *Gloeocapsa* and *Stigonema* in cephalodia. Furthermore, the form of the algal cells varies greatly, since continued division

causes them to become closely pressed together. Also (especially in species with scrobiculate cephalodia) filaments of *Stigonema* often appear like those of *Nostoc,* the division into the third plane being rather late in development. Mistakes in identification are easily made and especially so in free-hand sections mounted in glycerine or lactophenol and stained with such dyes as eosin, methyl blue, etc. For clarity in determination, embedding in a suitable medium and staining with iron-alum haemotoxylin is recommended (the process used to make the counts recorded below). Since, as Th. Fries (1866) postulated, the algae undergo morphologic changes during the development of the cephalodium, they are at least a rather unstable taxonomic character.

Although it is true that changes during development take place, Schwendener's observation that various genera of algae occur in the cephalodium is equally true. Table III shows the results of the examination of a large number of cephalodia from several species, with an enumeration of the different genera of algae found.

Thus the genera of algae enclosed may vary considerably within a species, especially in the group with scrobiculate ceph-

TABLE III

VARIATION OF CEPHALODIAL GONIDIA IN CERTAIN SPECIES OF STEREOCAULON

Type of cephalodia	Species	Collections examined	Cephalodia examined	Remarks[1]
Spherical	*alpinum*	10	250	3.6% S.; 96.4% N.
	denudatum	5	100	94% S.; 6% N.
	paschale	10	250	96.4% S.; 5.6% N.[2]
	tomentosum	10	250	3.2% S.; 97.2% N.
Botryose	*exutum*	8	250	98.4% G.; 2.4% N.
	japonicum	5	50	100% G.
	prostratum	4	100	97% S.; 3% N.
Scrobiculate	*mixtum*	·10	100	13% G.; 27% S.; 63% Sc.
	nesaeum	5	100	76% Sc.; 25% S.
	proximum	10	100	32% G.; 68% S.; 3% Sc.
	ramulosum	10	250	60.4% G.; 35.6% S.; 6.8% Sc.

[1] S = *Stigonema,* N = *Nostoc,* G = *Gloeocapsa* or *Chlorococcus,* Sc = *Scytonema.*
[2] When the sum of the percentages is greater than 100 per cent the presence of more than one algal genus in one or more cephalodia is indicated.

alodia. Perhaps one of the reasons for this is to be found in the fact that all the specimens examined with botryose cephalodia came from a limited area in Japan, those with spherical cephalodia came for the greater part from North America, whereas those of the scrobiculate group were collected in more scattered localities. Yet, whatever may be the limitations of the data, one point is unavoidable: i. e., that there is a variability in the algal content of the cephalodium, both in regard to the genera present and to the morphological appearance during development. For this reason it seems that species based on the nature of the cephalodial content alone cannot stand. Several species are evidently differentiated on the basis of this single character (e. g., *Stereocaulon ramulosum, S. mixtum,* and *S. proximum; S. nesaeum* and *S. Massartianum).* The data accumulated point to the fact that only the oldest name in each group of examples given above is valid and that the later segregates should not be accepted unless additional morphological characters are found upon which they can be based.

Discussion

From the above considerations it seems logical to diagram the probable relationships within the genus *Stereocaulon* as shown in fig. 2. The primitive species apparently have short, few-septate spores, a persistent primary thallus, cephalodia on the primary thallus, few-branched podetia, granular phyllocladia, and minute, sessile cephalodia. From this group, possibly by subjection to severe environmental conditions that did not favor growth, the cephalodia (and often the apothecia) disappeared, and the phyllocladia often became greatly reduced. Some species of the primitive spherical group lost the primary thallus and became large and branching. With an increase both in spore size and septation, and a corresponding increase in correlated apothecial and vegetative characters, the line of evolution continued upward in three directions; one terminating in species with botryose, another in species with scrobiculate cephalodia, and the third containing the spherical ancestral type.

Although this study was to emphasize primarily the taxonomic and phylogenetic significance of these structures it is felt that some evidence has accumulated to assist in determining their true nature, about which little is known. Th. Fries (1866) gave no reason for his statement that the alga was

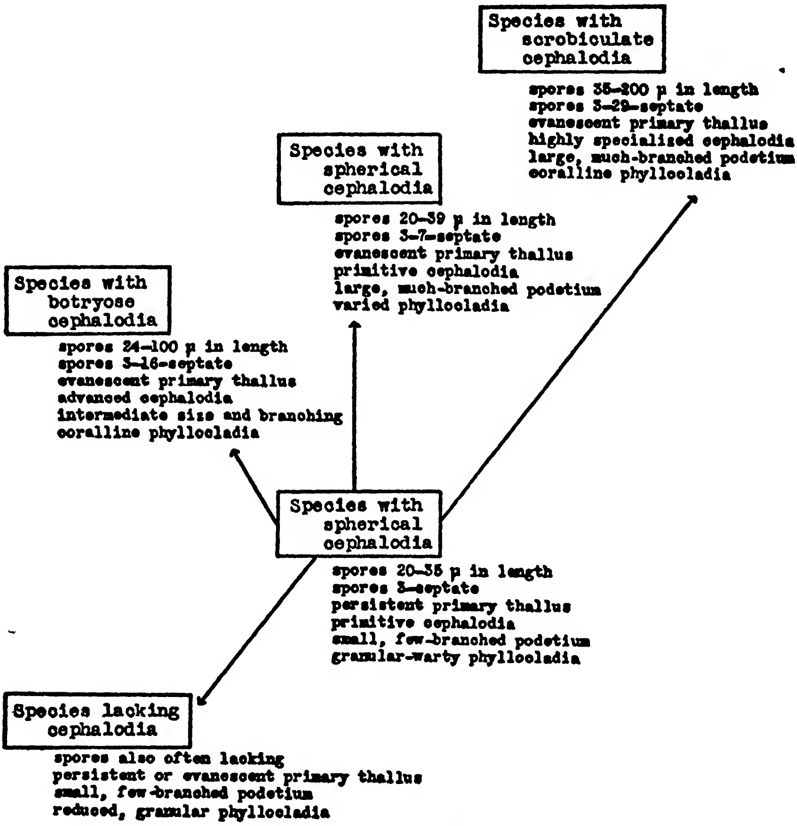


Fig. 2. A diagrammatical presentation of the phylogenetic connections within the genus *Stereocaulon* suggested in the text.

parasitic, nor did Schwendener (1869) who agreed with him. Winter (1877) designated cephalodia as parasitic structures, although he pointed out that the stimulus of the algae gives rise to unusual growth. Because of this increased growth one must conclude that the algae provide the hyphae with nourishment or cause them to hypertrophy through the effect of dis-

ease. Since the hyphae in no way appear diseased (although the algae often die) only the former opinion is tenable. The fact that there are fewer algal cells in young cephalodia and more in old ones proves that the algae, in spite of being surrounded by the hyphae, remain alive for some time and are capable of carrying on their life processes, even though they are visibly impaired by association with the fungus. Notwithstanding these facts, most writers regard cephalodia as pathologic structures! Reinke (1895) gave no evidence for considering them parasitic and left open the possibility that they are profitable to the lichen through power of assimilation. Winter (1877) and Babikof (1878) did describe some phenomena which were emphasized by Kaule ('32) to support his contention that cephalodia are harmful to the lichen. Goebel ('26) claimed to have seen hyphae penetrating from the cephalodium into the green algal layer and on into the thallus. Because of this anatomical appearance he considered cephalodia to be haustorial galls living parasitically on the lichen host. Darbishire ('27) could not find the haustorial hyphae Goebel mentioned. Kaule ('32) believed that he had proved the pathological nature of cephalodia, the evidence from an anatomical study of many groups seeming to point in that direction. This evidence is based largely upon the confirmation of Goebel's observation in a large number of genera and species, i. e., that hyphae from the cephalodium penetrate the lichen thallus into the green algal zone and bring about the destruction of the gonidial layer and its associated hyphae. In an additional report, Darbishire ('32) again stated that he could not find the haustorial hyphae referred to by Goebel ('26, '28) and Kaule ('32), and that he did not believe cephalodia to be haustorial structures. Kaule has also written a second paper ('34) upholding his previous statements.

So much has been written about the exact nature of the relation of the fungus to the alga in the lichen that it is hard to apply terms to the group as a whole. Schwendener, for instance, conceived of lichen symbiosis as the parasitism of a fungus on an alga, whereas M. and Mme. Moreau prefer to

think of the lichen as a disease of the fungus caused by the alga, in which the fungus is galled as insects gall phanerogams. Darbishire ('27) has noted the difficulty in showing that anatomically the fungus can be designated diseased by the alga, biologically as living peacefully with the alga for the good of the whole, and physiologically as active upon the alga. However that may be, this paper is not an attempt to decide the relationship of the alga to the fungus in the lichen body. The impression has been left by those who consider cephalodia parasitic bodies (Goebel, '26, '28; Kaule, '32, '34) that the cephalodium attacks the thallus (or podetium) in such a manner as to damage the organism. The writer cannot say whether or not this is true in all cephalodia-bearing groups; the opinion expressed here applies only in the case of *Stereocaulon.* It seems that in this genus cephalodia are beneficial to the organism rather than the injuring influences one might be led to believe. If of any benefit it must be vegetative in character (since only asexual elements are involved). Table II shows that specialized cephalodia occur on the podetia of the most vigorous species and there is usually a good correlation between the size of the lichen and the number of cephalodia on the plant. The most primitive species have poorly developed cephalodia, and since these organs have phylogenetic significance it seems reasonable to assume long, continuous, mutualistic relationship. None of the factors upon which Kaule ('32) based his belief that cephalodia in lichens are harmful have any foundation in *Stereocaulon,* since there is no continuous green algal gonidial zone in mature podetia. He even stated that no harm to the thallus by the cephalodium can be ascertained in this genus. This observation is here confirmed in every detail; neither macro- nor microscopic injury can be found. It may be possible to consider cephalodia pathological structures in other genera; indeed there is some evidence to support this view, but it is impossible to extend that concept to the genus treated here.

It does seem rather absurd, however, even in other genera, to imagine the hyphae of a perfectly healthy lichen forming a

union with an alga that grows more vigorously autotrophically than in the combined state, and to consider that the alga benefits and that the lichen is damaged because of such an association. The fungus is always the active component; the alga remains passive during the entire development. That the algae are capable of living outside of the lichen is testified by their healthy, normal appearance on the exterior of the podetium, in the tomentum, and on nearby soil. Babikof (1878) took them from cephalodia of *Peltigera aphthosa* and grew them for five weeks on sterile soil. Once inside the cephalodium, the alga, though apparently still in good condition, never retains the appearance it had in solitary life. Whether this is harmful to the blue-green algae might be debatable, but if the presence of dead algae is considered a good criterion (and Schwendener, 1867, 1869, and Bornet, 1873, have considered this the best support for the parasitic interpretation of lichen symbiosis), we can certainly consider that the fungus utilizes the algae of the cephalodium, for numerous algae are found dead there; moreover, they are often totally absorbed by the lichen.

Then there are several anatomical evidences in favor of the viewpoint upheld in this paper. (1) The definite wall structure such as is found in the scrobiculate type does not completely surround the algal mass, but only the outer part (pl. 68, fig. 5). When compared to insect galls, it should be noted that the insect is completely enclosed. Such is never the case in cephalodia of this genus; the algae are surrounded toward the outside and toward the inside are in actual contact with the lichen thallus, being in direct communication with the central cylinder of the podetium. (2) The fungal hyphae adhere closely to the algal components as though they were providing an absorption mechanism for the foodstuffs possibly produced at those points (pl. 67, figs. 5 and 12; pl. 68, figs. 6 and 10). (3) The conducting core leads to the central cylinder of the lichen, providing intimate connection with the cephalodium at all times (pl. 68, fig. 7). It seems hard to explain the presence of these structures unless they are used for the benefit of the fungus. Conclusive proof of the manner in which this bene-

ficial action takes place is not available, but Cengia Sambo ('23, '26, '31) and Darbishire ('24, '27) have suggested that cephalodia function in the fixation of nitrogen. This would explain the absence of cephalodia on some specimens; possibly they were growing on soil or rock where considerable nitrogenous matter was available. In 1926 (confirmed in '31) Cengia Sambo called attention to *Azotobacter* occurring in the gelatinous sheath surrounding the gonidia of the cephalodium. She postulated a symbiotic relationship between the bacterium, the fungus, and the algae. It is at least true that bacteria can often be seen in sections of cephalodia. At any rate, the action of cephalodia for the benefit of the lichen-fungus seems to be the most plausible hypothesis as far as species of *Stereocaulon* are concerned.

Correlation of Cephalodial Types with Geographical Distribution

Species with spherical cephalodia are distributed throughout the entire world as would be expected from their primitive condition, although they are more frequent in the northern hemisphere. The species of the north boreal zone are almost wholly of this type. That group which lacks cephalodia occurs intermittently but is to be found either in northern latitudes or in high altitudes, indicating perhaps the severe climatic conditions associated with the reduced nature of the species. Species with botryose cephalodia occupy a limited area in eastern Asia while those with scrobiculate cephalodia occur mainly in the tropics and in the southern hemisphere, though they rarely reach the southern extremity of the north temperate zone. Thus each advanced type of cephalodium occurs in a more or less restricted area. There is nothing in the actual geographical distribution to indicate that the grouping of the species of *Stereocaulon* as proposed in this paper is not a natural method.

Summary

The cephalodia of *Stereocaulon* have been studied comparatively from the standpoint of their taxonomic and phylogenetic

value. The following conclusions seem justified with regard to this particular genus:

(1). That the gross morphology of the cephalodium is a good taxonomic character, and on this basis three types are recognized.

(2). That the presence of a cephalodium is an advanced character.

(3). That the cephalodia are not pathological structures, but seem to be beneficial to the entire lichen.

(4). That a small, sessile, spherical cephalodium is the primitive type. This is correlated with spore length and septation, the condition of the primary thallus, various apothecial characters (as length of asci, height of hymenium, and thickness of hypothecium), and in the habit or general appearance of the plant expected from a consideration of the evolutionary tendencies in the family to be primitive.

(5). That a certain group of species, having once acquired cephalodia, later lost them, the reduction being evident in the nature of the phyllocladia, in the general habit of the plant, and often in the loss of apothecia.

(6). That species with botryose and scrobiculate cephalodia represent well-stabilized advanced types, the cephalodial advances being correlated with the advances in other characters expected within the genus.

(7). That, on the basis of all data available, a phylogenetic scheme, such as is diagrammed on page 754, may be logically held to show evolutionary tendencies within the genus.

(8). That the type of alga in the cephalodium has no taxonomic, much less phylogenetic, significance, both because of the morphological variation during development and the variation in the genera of algae.

(9). That a study of the origin and development of cephalodia confirms the phylogenetic sequence presented; the primitive type of cephalodium being without definite wall, form, or stipe; the botryose type usually possessing a definite form and stipe, but a loosely developed wall; the scrobiculate type possessing a well-developed stipe, form, and wall. The origin and development of each of these types is described.

(10). That the geographical distribution of these groups is in agreement with the opinions expressed in this thesis.

The validity of the data presented in this paper can be determined only by the completion of a monograph of *Stereocaulon.* It is only in such a work that the most accurate placement of species according to their natural relationship can be made. At present more complete information must be obtained in regard to the cephalodial and other morphological characters of many, as yet poorly understood species.

ACKNOWLEDGMENTS

The author is deeply indebted to the staff of the Missouri Botanical Garden for the privilege of its facilities of research and instruction, especially to Dr. C. W. Dodge, who has kindly allowed his private herbarium and library to be consulted and who has directed the problem.

LITERATURE CITED

Acharius, E. (1803). Methodus Lichenes. lv + 394 pp. *8 pls.* Stockholm.

————, (1810). Lichenographia Universalis. viii + 696 pp. *14 pls.* Göttingen.

Babikof, M. (1878). Du développement des céphalodies sur le thallus du lichen *Peltigera aphthosa* Hoffm. Acad. Imp. Sci. St.-Pétersbourg, Bull. **24**: 547–559. *1 pl.*

Bornet, E. (1873). Recherches sur les gonidies des lichens. Ann. Sci. Nat. Bot. V. **17**: 45–110. *11 pls.*

Cengia Sambo, M. ('23). Polisimbiosi nei licheni a cianoficee e significato biologico dei cefalodi. Soc. Ital. Sci. Nat. e Mus. Civ. Stor. Nat. Milano, Atti **62**: 226–238.

————, ('26). Ancora della polisimbiosi nei licheni ad alghe cianoficee. I batteri simbionti. *Ibid.* **64**: 191–195.

————, ('31). Biologie des lichens. Les substances carbohydratées dans les lichens et la fonction de fixation de l'azote des céphalodes. Soc. Internaz. Microbiol., Boll. Sez. Ital. **3**: 699–704.

Darbishire, O. V. ('24). Some aspects of lichenology. Brit. Mycol. Soc., Trans. **10**: 10–28. *1 fig.*

————, ('27). Ueber das Wachstum der Cephalodien von *Peltigera aphthosa* L. Ber. deutsch. bot. Ges. **45**: 221–228. *1 pl.*

————, ('32). Weiteres über die Cephalodien von *Peltigera aphthosa* L. *Ibid.* **50**: 178–184. *1 pl.*

Dodge, C. W. ('29). A synopsis of *Stereocaulon* with notes on some exotic species. Ann. Cryptog. Exot. **2**: 93–153.

Elfving, F. ('13). Untersuchungen über die Flechtengonidien. Soc. Scient. Fenn., Acta **44**[2]: 1–71. *8 pls.*

————, ('31). Weitere Untersuchungen über Flechtengonidien. *Ibid.* N. S. B. **1**[1]: 1–30. *13 pls.*

Flörke, H. G. (1819). Deutsche Lichenen. Fasciculus IV. Rostock. 1819. [Paper not seen; cited from Smith, '21.]

Forssell, K. B. J. (1883). Studier öfver cephalodierna. Bihang till Kongl. Svensk. Vetensk.-Akad. Handl. **8**[3]: 1–112. *2 pls.*

————, (1884). Lichenologische Untersuchungen. I. Ueber die Cephalodien. Flora **67**: 1–8, 33–46, 58–63, 177–193.

————, (1885). Anatomie und Systematik der Gloeolichenen. Reg. Soc. Sci. Upsala, Nov. Act. III. **13**[6]: 1–118.

Frey, E. ('33). in: Rabenhorst's Kryptogamen-Flora von Deutschland, Osterreich und der Schweiz. IX. Flechten, Abt. IV, Hälfte 1, Lief. 1. Cladoniaceae (unter Ausschluss der Gattung *Cladonia)* und Umbilicariaceae. 208 pp. *32 figs.*

Fries, Th. M. (1857). De Stereocaulis et Pilophoris Commentatio. 42 pp. Upsala.

————, (1858). Monographia Stereocaulorum et Pilophororum. Reg. Soc. Sci. Upsala, Acta III. **2**: 307–380. *4 pls.*

————, (1866). Beiträge zur Kenntniss der sog. Cephalodien bei den Flechten. Flora **44**: 17–25.

Fünfstück, M. ('26). Lichenes. Allgemeiner Teil. in: Engler-Prantl, Die natürlichen Pflanzenfamilien. 2 Aufl. **8**: 1–60. *31 figs.*

Gilbert, E. J. ('27). Les livres du mycologue. Tome I. La spore des champignons supérieurs. 221 pp. *1 fig. 1 pl.* Paris.

Goebel, K. ('26). Morphologische und biologische Studien. VII. Ein Beitrag zur Biologie der Flechten. Jard. Bot. Buitenzorg, Ann. **36**: 1–83. *4 pls.*

————, ('28). *Ibid.* XV. Rückblick. *Ibid.* **39**: 203–232. *7 figs.*

Hoffmann, G. F. (1795). Deutschlands Flora. Cryptogamie. 200+ pp. *13 pls.*

Hue, A. M. (1898). Lichenes extra-Europaei a pluribus collectoribus ad Museum Parisiense missi. Mus. d'Hist. Nat. Paris, Nouv. Archiv. III. **10**: 213–280.

————, ('11). Monographiam generis *Solorinae* Ach. Morphologice et anatomice, addito de genere *Psoromaria* Nyl. Appendice. Soc. Nat. Sci. Nat. et Math. Cherbourg, Mém. **38**: 1–56.

Kaule, A. ('32). Die Cephalodien der Flechten. Flora **126**: 1–44. *16 figs.*

————, ('34). Ueber die Cephalodien der Flechten. (2. Beitrag.). *Ibid.* **127**[4]: 345–361.

Magnusson, A. H. ('26). Studies on boreal Stereocaula. Göteborgs Kungl. Vetensk.- och Vitterh.-Sammhall. Handl. IV. **30**[7]: 1–89.

Moreau, F. ('21). Recherches sur les lichens de la famille des Stictacées. Ann. Sci. Nat. Bot. X. **3**: 297–376. *20 figs. 4 pls.*

————, ('28). Les lichenes. Morphologie, biologie, systematique. 146 pp. *65 figs. 2 pls.* Paris.

———— (M. et Mme.), ('15). La signification biologique des céphalodies des lichens. Soc. Bot. France, Bull. **62**: 249–250.

————, ('18). La biomorphogénèse chez les lichens. Soc. Mycol. France, Bull. **34**: 84–85.

————, ('19). Recherches sur les lichens de la famille des Peltigéracées. Ann. Sci. Nat. Bot. X. **1**: 29–137. *23 figs. 13 pls.*

——————, ('32). Sur un lichen du genre *Stereocaulon* Shreb., le *St. coralloides* Fries. Soc. Bot. France, Bull. **79**: 508–515. *5 figs.*

Nylander, W. (1858–1860). Synopsis Methodica Lichenum. **1**: iv + 430 pp. *8 pls.* Paris.

——————, (1876). Céphalodies. in: Baillon's Dictionnaire de Botanique **1**: 698.

——————, (1888). Lichens Novae Zelandiae. 156 pp. *1 pl.* Paris.

Redinger, K. ('36). Zwei phyllocladienlose, rasenbildende *Stereocaulon*-Arten aus Neuseeland. Hedwigia **76**: 131–139. *3 figs.*

Reinke, J. (1894–1896). Abhandlungen über Flechten. I. Das Podetium von *Cladonia.* Jahrb. f. wiss. Bot. **26**: 495–523. *7 figs.* 1894; II. Die Stellung der Flechten im Pflanzensystem. *Ibid.* **26**: 524–542. 1894; III. Einige Voraussetzungen einer phylogenetischen Morphologie der Flechten. *Ibid.* **28**: 39–69. *1 fig.* 1895; IV. Skizzen zu einer vergleichenden Morphologie des Flechtenthallus. *Ibid.* **28**: 70–150. *74 figs;* 358–486. *113 figs.* 1895; V. Das natürliche Flechtensystem. *Ibid.* **29**: 171–236. *15 figs.* 1896.

Riddle, L. W. ('10). The North American species of *Stereocaulon.* Bot. Gaz. **50**: 285–304. *9 figs.*

Schärer, L. E. (1833). Lichenum Helveticorum Spicilegium. Part I. Section VI. 263–319. Bern.

Schneider, A. (1897). A textbook of general lichenology. xvii + 230 pp. *76 pls.* Binghampton, N. Y.

Schwendener, S. (1860). Untersuchungen über den Flechtenthallus. Nägeli's Beitr. wiss. Bot. Leipzig. **2**: 109–186. *7 pls.*

——————, (1867). [Summary of paper presented.] in: Protokoll der botanischen Sektion, Schweiz. Naturforsch. Ges. in Rheinfelden, Verhandl. 51 Jahresversammlung. 88–90.

——————, (1869). Die Algentypen der Flechtengonidien. 42 pp. *3 pls.* Basel.

Smith, A. L. ('21). Lichens. xxviii + 464 pp. *135 figs.* Cambridge.

Sprengel, C. (1827). Systema Vegetabilium. **4**[1]: 592 pp. Göttingen.

Taylor, T., and J. D. Hooker (1844). Lichens. in: Hooker, J. D. The botany of the Antarctic voyage of H. M. discovery ships *Erebus* and *Terror* in the years 1839–1843. Fl. Antarct. Pt. I. xii + 208 pp. *80 pls.* London.

Tobler, F. ('32). Zur Entwicklungsgeschichte des Flechtenkörpers. Ber. deutsch. bot. Ges. **50**: 237–247. *8 figs.*

Wainio, E. A. (1897). Monographia Cladoniarum Universalis. Pars tertia. Soc. pro Fauna et Flora Fenn., Acta **14**[1]: 1–268.

——————, ('15). Additamenta ad Lichenographiam Antillarum illustrandam. Acad. Scient. Fenn., Ann. A. **6**[7]: 1–226.

Wallroth, F. W. (1825). Naturgeschichte der Flechten. Erster Theil. lviii + 723 pp.

Watson, W. ('29). The classification of lichens. I. New Phytologist **28**: 1–36. II. *Ibid.* **28**: 85–116.

Weber, G. H. (1778). Spicilegium Florae Goettingensis. 288+ pp. Gotha.

Winter, G. (1877). Lichenologische Notizen. I. Cephalodien von *Sticta* und *Solorina.* Flora **60**: 177–184; 193–203; 213–214. *1 pl.*

Zahlbruckner, A. ('26). Lichenes. Spezieller Teil. in: Engler-Prantl, Die natürlichen Pflanzenfamilien. 2 Aufl. **8**: 61–263. *96 figs.*

——————, ('27). *Stereocaulon.* Catalogus Lichenum Universalis. **4**: 627–674.

EXPLANATION OF PLATE

PLATE 66

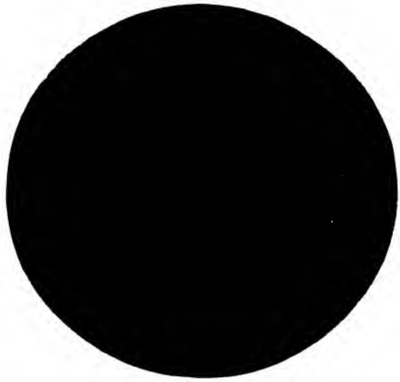
Cephalodia of *Stereocaulon* illustrating their varied gross morphology (× approx. 10 diameters).

Figs. 1 and 2. Podetial segments dissected from a species belonging to the group with spherical cephalodia. Fig. 1 shows a vertical view of three adjacent spherical cephalodia; fig. 2, a lateral view of a single cephalodium.

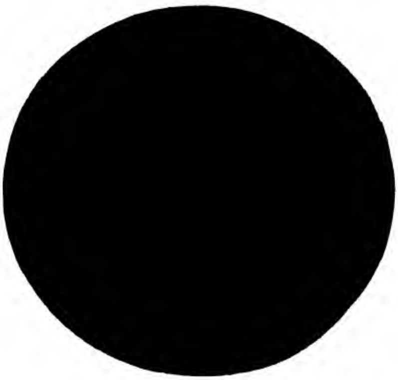
Figs. 3 and 4. Podetial segments dissected from a species belonging to the group with botryose cephalodia. Fig. 3 is a vertical, and fig. 4 a lateral view of cephalodia borne on them.

Figs. 5 and 6. These figures illustrate two podetial segments dissected from species belonging to the group with scrobiculate cephalodia. In both cases the cephalodia are seen in lateral view.

1

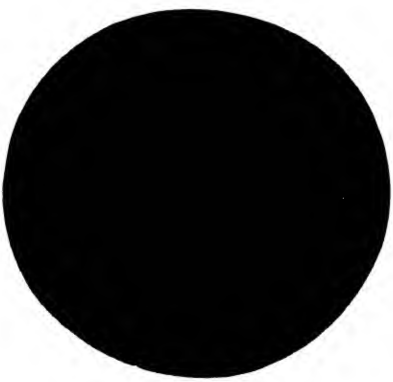


2



3

4



5

6

JOHNSON—CEPHALODIA OF STEREOCAULON

Explanation of Plate

PLATE 67

Photomicrographs illustrating the origin and development of cephalodia. (Magnifications approximately as follows: fig. 15, × 35; figs. 4, 7, and 10, × 60; figs. 1 and 6, × 175; figs. 2–3, 5, 8–9, 11–14, × 270 diameters.)

Figs. 1–8. Representative stages in the development of spherical cephalodia. (All photographs are of cephalodia taken from the same collection of one species.)

Fig. 1. A very early stage in the development of a cephalodium.

Fig. 2. A stage slightly later in development than fig. 1.

Fig. 3. A stage somewhat similar to fig. 2, but showing further growth and differentiation by the fungal hyphae.

Fig. 4. Vertical section through the median plane of a relatively young cephalodium.

Fig. 5. The algal masses and associated fungal hyphae.

Fig. 6. Cross-section through the upper part of a cephalodium.

Fig. 7. Vertical section of a mature cephalodium.

Fig. 8. Enlargement of the cephalodial wall, showing the peripheral orientation of the hypae of which it is composed.

Figs. 9–15. Representative stages in the development of botryose cephalodia. (All photographs are of cephalodia taken from the same collection of one species.)

Fig. 9. A young cephalodium.

Fig. 10. The algae are separated into individual cells.

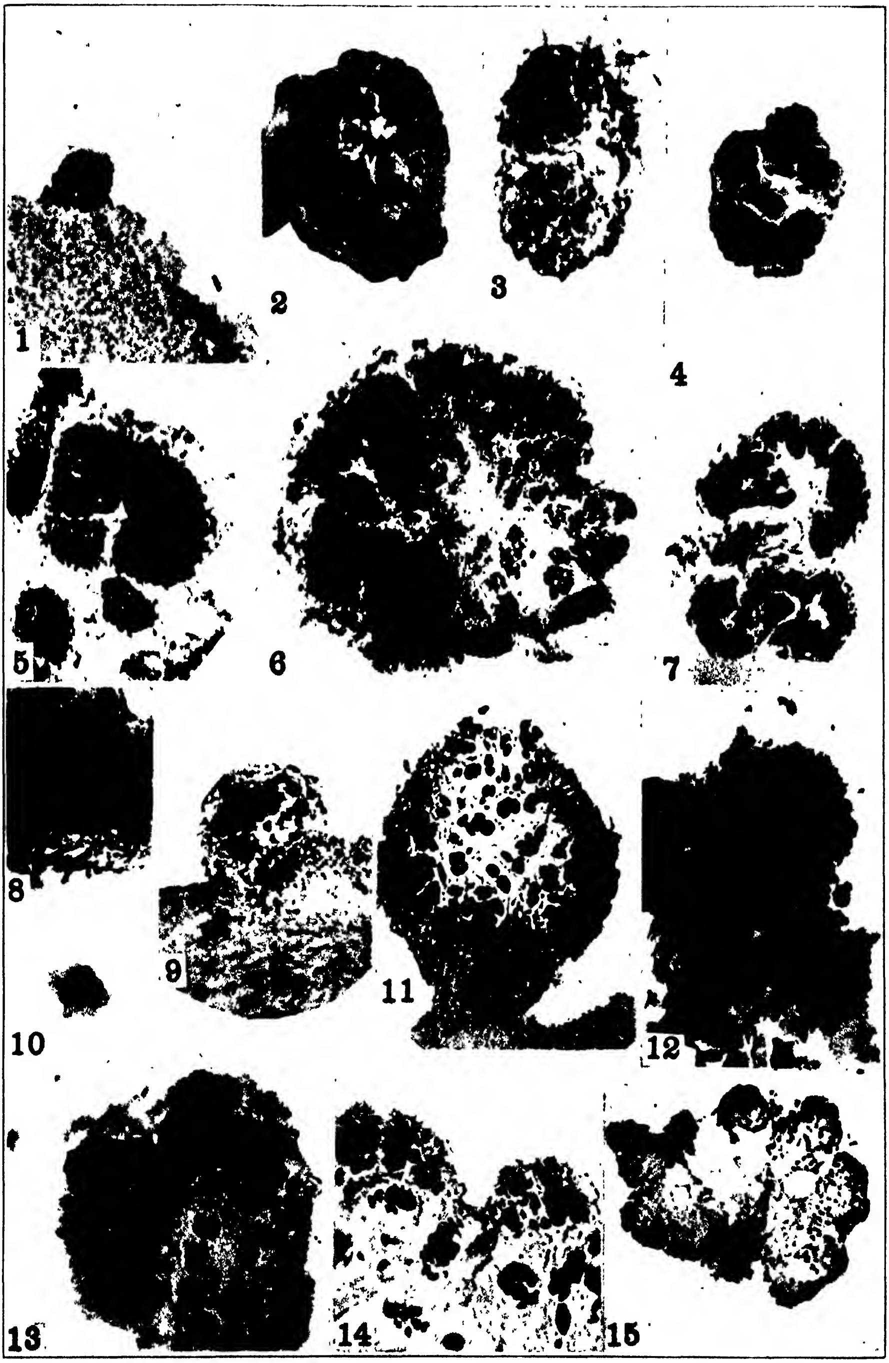
Fig. 11. Early stage in the disappearance of the gelatinous sheath shown in fig. 12.

Fig. 12. Section through a cephalodium showing the "capsular" gelatinous sheath and associated fungal hyphae.

Fig. 13. Hyphal plates give a chambered effect to the cephalodium.

Fig. 14. Enlargement of the cephalodial wall.

Fig. 15. A relatively mature cephalodium seen in vertical section through the median plane.



JOHNSON—CEPHALODIA OF STEREOCAULON

EXPLANATION OF PLATE

PLATE 68

Photomicrographs illustrating the origin and development of cephalodia. (Magnifications approximately as follows: figs. 4, 5, and 11, × 65; fig. 7, × 260; the rest, × 285 diameters.)

Figs. 1–13. Representative stages in the development of scrobiculate cephalodia. (Figs. 1–3, 6, 8, 10, and 13 are from the same collection of one species; the rest are from a single collection of another species.)

Fig. 1. Small algal cells surrounded by hyphae from the podetium.

Fig. 2. Young cephalodium developing on the wall of an older cephalodium.

Fig. 3. Young cephalodium.

Fig. 4. A relatively young cephalodium.

Fig. 5. Same as fig. 4, but at a later stage. Note especially the connection of the hyphae of the conducting core of the cephalodium with the central cylinder of the podetium.

Fig. 6. Algae from a young cephalodium.

Fig. 7. Enlargement of a sector of fig. 5, showing in detail the connection of the cephalodium with the central cylinder of the podetium.

Fig. 8. A cross-section of the cephalodial wall.

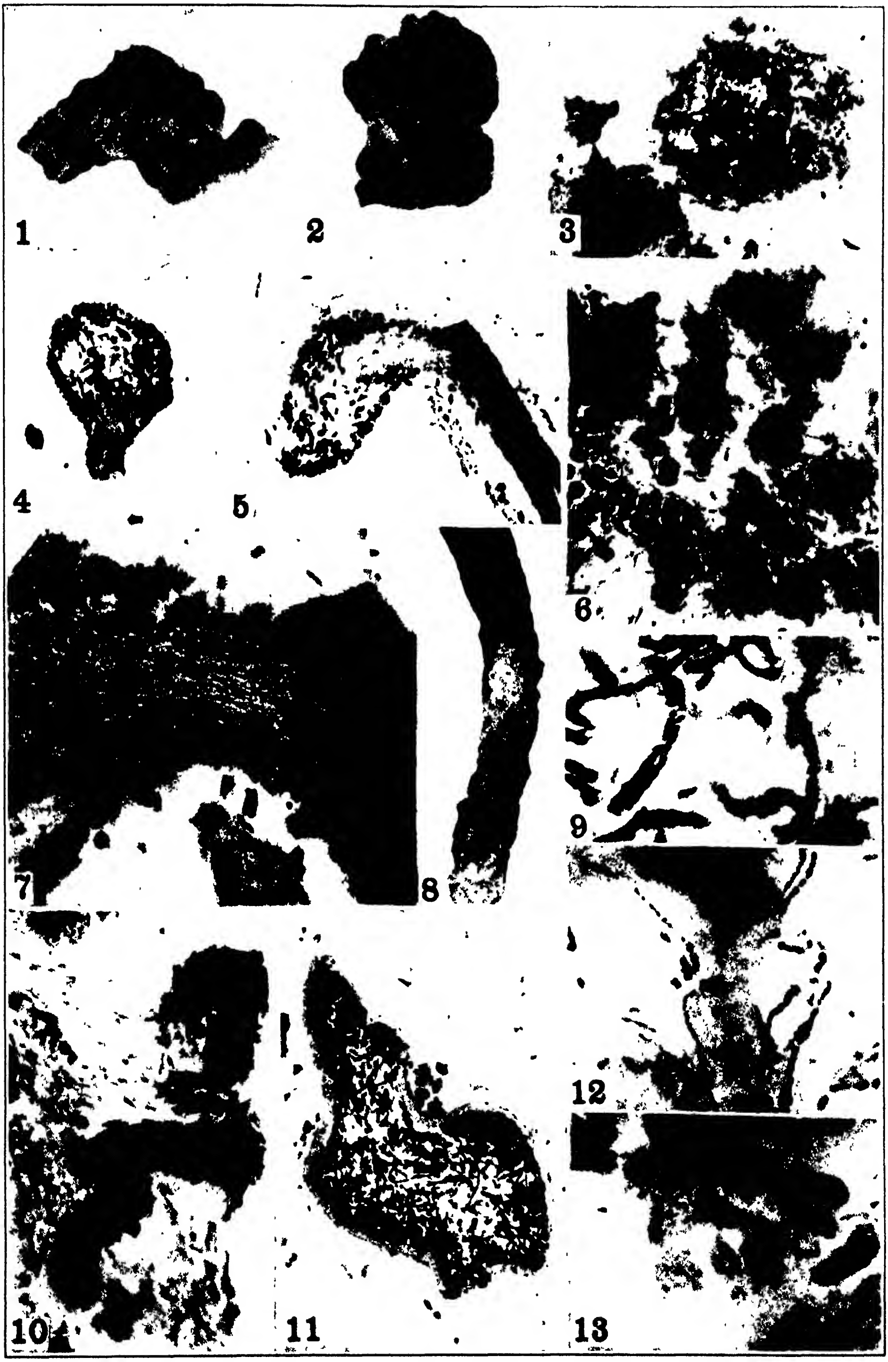
Fig. 9. Stages in the deterioration of the algae, found in older cephalodia.

Fig. 10. Algae from a relatively early stage in cephalodial development. Note the capsular structure of the algal clusters.

Fig. 11. Cross-section of a mature cephalodium.

Fig. 12. An advanced stage in the destruction of the algae in the cephalodium.

Fig. 13. Similar to fig. 12. Contrast with fig. 6, which shows the normal appearance of this species of algae.



JOHNSON—CEPHALODIA OF STEREOCAULON

NEW VARIETIES AND FORMS FROM MISSOURI

ERNEST J. PALMER

Collector and Research Assistant, Arnold Arboretum of Harvard University

AND JULIAN A. STEYERMARK

Assistant Curator of Herbarium, Field Museum of Natural History, Chicago

Taxodium distichum f. **confusum**, f. nov., ramulis arcuato-adscendentibus; foliis brevioribus et plus adpressis quam forma typica.

Occasionally found with the typical form, usually in open or sunny situations.

In this form of the bald cypress the tips of the branches curve upwards, which gives a bushy or fastigiate appearance to the tree. The leaves are shorter, crowded, and more appressed to the branches than in the typical form, producing a somewhat spruce-like effect. Branches and leaves of normal type are sometimes found on the lower part of the tree.

This form should not be confused with *Taxodium ascendens* Brong. (*T. distichum* var. *imbricatum* Groom), which it somewhat resembles in extreme forms but from which it differs in the usually less subulate leaves and in the smoother bark. *Taxodium ascendens* is not found so far inland.

MISSOURI: Markham Springs, 3 mi. w. of Williamsville, Wayne Co., June 28, 1936, *J. A. Steyermark 11261* (MBG type),[1] *11170* (MBG paratype). ILLINOIS: Shawneetown, Gallatin Co., June 14, 1919, *E. J. Palmer 15482*, and May 12, 1923, *22589*; Metropolis, Massac Co., Sept. 16, 1923, *E. J. Palmer 23752*; McClure, Alexander Co., Sept. 29, 1919, *E. J. Palmer 16625*. ARKANSAS: Fulton, Hempstead Co., June 10, 1909, *B. F. Bush 5813*. Isotype and other specimens, A.A.

Salix sericea f. **glabra**, f. nov., foliis maturis glabris subtus.

Low ground and swampy meadows along streams, northeastern Ozark region and probably occasionally elsewhere with the typical form.

---

[1] In the citation of specimens the following abbreviations have been used: A.A.—Arnold Arboretum Herbarium; G.—Gray Herbarium; MBG.—Missouri Botanical Garden Herbarium.

This form of the silky willow differs from the normal type in having the under-surface of the mature leaves glabrous. Specimens from other regions have been seen in which the young leaves on new growth are silky while those on the older branches are glabrous as in this form. In some parts of the Ozark region the glabrous form is the only one found.

MISSOURI: along north prong (Hutchins Creek) of Meramec River, between Stone Hill and Indian Trail State Park, Dent Co., Aug. 4, 1936, *J. A. Steyermark 12918* (MBG type); along Brushy Creek, 1 mi. north of Moses Store, Reynolds Co., Aug. 13, 1936, *J. A. Steyermark 12918* (MBG paratype).

Salix cordata f. **mollis**, f. nov. A typo differt foliis pubescentibus praesertim costa media subtus, petiolis ramulisque pubescentibus.

From the ordinary *S. cordata* Muhl. this form differs in the more pubescent under-surface of the leaves, especially along the midrib, and in the pubescent petioles and branchlets.

Swampy meadows and wet open ground along small streams.

MISSOURI: along spring branch of Twin Springs, between Stone Hill and Indian Trail State Park, Dent Co., Aug. 4, 1936, *J. A. Steyermark 12491* (MBG type); along Moline Creek, 7 mi. from St. Louis, April 14 and Sept. 2, 1895, *N. M. Glatfelter 25;* along Turkey Creek, near Joplin, Jasper Co., May 20, 1909, *E. J. Palmer 2043*, and July 18, 1920, *18415;* Oasis, Taney Co., June 2, 1931, *E. J. Palmer 39492*. All specimens except type and paratype in A.A.

Salix cordata f. **subintegra**, f. nov., foliis subintegris.

This odd form differs from normal *S. cordata* in its subentire instead of sharply serrulate leaves.

Wet rocky banks and swampy open ground.

MISSOURI: shore of lake at Yancy Mills Spring, Phelps Co., Nov. 28, 1936, *J. A. Steyermark 20910* (MBG type)

Carya Buckleyi var. **arkansana** f. **glabra**, f. nov., foliis glabris; ramulis annotinis glabris vel fere glabris.

Occasionally found with the common pubescent forms in dry rocky woods, especially on cherty ridges or hillsides.

In typical *C. Buckleyi* and in the varieties *arkansana* and *villosa* the under-surfaces of the leaves and the young branchlets are thickly covered with tawny puebscence mixed with small, scurfy, silvery scales, the pubescence persisting at least along

the veins of the leaves at maturity and on the branchlets to the end of the season. This new form differs in having the mature leaves and branchlets glabrous or essentially so. It can best be distinguished from forms of *Carya ovalis* by the pubescent, scurfy winter-buds and by the fruit which is generally larger with a thicker, scurfy involucre. The amount of pubescence in this and most other species of *Carya* is quite variable, and a complete series of intermediate forms may be found.

MISSOURI: upland cherty pine woods near Cane Creek, 10 mi. southeast of Ellsinore, Butler Co., July 8, 1936, *J. A. Steyermark 11461* (type MBG); 5 mi. northwest of Bunker, Reynolds Co., July 30, 1936. *J. A. Steyermark 12363* (MBG); Campbell, Dunklin Co., Oct. 6, 1912, *B. F. Bush 6897* (A.A. paratype); near Joplin, Jasper Co., Oct. 9, 1909, *C. S. Sargent & E. J. Palmer 2809* (A.A.), and Oct. 8, 1911, *3494* (A.A.). ARKANSAS: Pine Bluff, Jefferson Co., Oct. 7, 1913, *C. S. Sargent* (A.A.).

Quercus falcata f. **angustior,** f. nov. A typo differt foliis angustioribus.

Rarely found with the typical form.

The leaves of the southern red oak are extremely variable in size, outline, and in the number and shape of the lobes. This form is distinguished by the unusually narrow leaves. While the leaves bear some resemblance to those sometimes found on hybrids of *Q. falcata* with *Q. Phellos (Q. ludoviciana* Sarg.), their comparatively symmetrical and uniform type and other characters do not suggest such an origin, and it is probably only an extreme form of the species that should be recognized.

MISSOURI: along Eleven-Points River, ½ mi. north of McCormack Hollow, 3 mi. north of Greer, Oregon Co., July 27, 1936, *J. A. Steyermark 12318* (MBG type).

Cardamine bulbosa f. **fontinalis,** f. nov., foliis basalibus et inferioribus late ovatis vel rotundatis, plus minusve basi cordatis.

This form of spring cress is found in springs and in the running water of spring branches in the Ozarks. The roots of such plants are finely fibrous and seldom develop bulblets as in the typical form. It sometimes looks quite distinct and has been confused with *Cardamine rotundifolia,* but it may be only an ecological form of the normal type.

MISSOURI: perennial branch from Pulltight Spring, Shannon Co., Aug. 2, 1936, *J. A. Steyermark 12414* (MBG type); in spring branch 4 mi. east of Carthage, Jasper Co., May 27, 1906, *E. J. Palmer 844* (MBG); near Reeds, Jasper Co., June 2, 1924, *E. J. Palmer 25272* (MBG); Tip Top, Iron Co., May 19, 1926, *E. J. Palmer 30181* (MBG).

Amelanchier canadensis f. **nuda**, f. nov. A typo differt foliis maturis glabris.

This form differs from typical *A. canadensis* in having the under-surface of the mature leaves and their petioles quite glabrous. It has sometimes been confused with *A. laevis* which apparently does not extend into Missouri or west of the Mississippi River, and the recognition of the glabrous form should obviate this mistake. The type specimen and other collections in northeastern Missouri were taken from large-sized trees (see Ann. Mo. Bot. Gard. **23**: *pl. 20, fig. 5*), but there is no positive evidence that the glabrous leaves and arborescent habit are generally associated.

MISSOURI: 5 mi. south of Linesville, Mercer Co., July 5, 1933, *E. J. Palmer & J. A. Steyermark 40317* (A.A., type); Livonia, Schuyler Co., July 1, 1933, *E. J. Palmer & J. A. Steyermark 41069* (A.A., paratype), and July 2, 1933, *41976;* Larussell, Lawrence Co., Oct. 2, 1908, *E. J. Palmer 1;* Monteer, Shannon Co., Oct. 5, 1920, *E. J. Palmer 19283;* Kahoka, Clark Co., May 19, 1929, *E. J. Palmer 25860;* Viola, Barry Co., Oct. 2, 1935, *B. F. Bush 15260;* LaGrange, Lewis Co., Oct. 9, 1913, *John Davis 2227;* bluffs of Mississippi River, Hannibal, Aug. 8, 1912, *John Davis 2011;* Riverside Park, Hannibal, Oct. 4, 1913, *John Davis 2101.* WEST VIRGINIA: Panther Mountain, Pendleton Co., June 15–19, 1925, *P. A. Rydberg 9052.* ARKANSAS: Magazine Mountain, Logan Co., Oct. 8, 1924, *E. J. Palmer 46431.* OKLAHOMA: Muskogee, Nov. 3, 1916, *E. J. Palmer 11200;* Page, LeFlore Co., Sept. 23, 1920, *E. J. Palmer 20569.* Specimens of all above numbers in A.A.; isotypes in MBG.

Ludvigia alternifolia var. **pubescens**, var. nov., foliis, caulibus et ovariis dense pubescentibus pilis brevibus patentibus.

Moist, sandy, open ground, southeastern lowlands, Mississippi Co., Mo.

The stem, leaves and ovaries in this form are densely pubescent with short spreading hairs, clearly distinguishing it from the typical variety.

MISSOURI: 4 mi. west of Charleston, July 11, 1933, *E. J. Palmer & J. A. Steyermark 41450* (MBG type; G isotype).

Sambucus canadensis f. **rubra,** f. nov. A typo differt fructibus rubris.

Occasionally found with the typical form, from which it differs only in the bright red fruit.

This form was first observed in northwestern Missouri. Specimens and seeds were sent to the Arnold Arboretum, where it was thought to represent a new species or variety, but as the cultivated plants did not survive, no description was published. More recently it has been collected in the vicinity of St. Louis by Mr. Oscar Petersen and the late Mr. Wendell Shay of that city, both of whom pointed out what they considered distinguishing characters in the number and shape of the seeds and fruit, time of fruiting, and leaf form. However, further study of living material and of a large series of herbarium specimens does not indicate that these slight differences are constant or are characteristic of the red-fruited form, and it seems best to consider it only a form of the common elderberry.

MISSOURI: Watson, Atchison Co., Sept. 3, 1920, *E. J. Palmer 18928* (A.A. type); from cultivated plants in grounds of Normandy High School, St. Louis Co. (originally collected in northern St. Louis Co.), Sept. 14, 1936, *J. A. Steyermark 20068* (MBG paratype).

ADDITIONS, CORRECTIONS, AND REVISIONS TO THE "ANNOTATED CATALOGUE OF THE FLOWERING PLANTS OF MISSOURI"

ERNEST J. PALMER

Collector and Research Assistant, Arnold Arboretum of Harvard University

AND JULIAN A. STEYERMARK

Assistant Curator of Herbarium, Field Museum of Natural History, Chicago

Since the publication of our "Annotated Catalogue" (Ann. Mo. Bot. Gard. **22**: 375–758. 1935) many changes in nomenclature have appeared, additional records have become available, and certain typographical errors in the work have been discovered. In order to bring all of these matters up to date in accordance with the most recent views, the data are here brought together. Changes in taxonomic treatment are based upon the judgment of the authors by whom they are published, but it should not be inferred that we agree with them in all cases.

p. 405, second column, line 22—*Cynosciadum* should read *Cynosciadium.*

p. 410, line 4—*Spirodela polyrhyza* should read *Spirodela polyrhiza.*

p. 413, first column, line 11—*Phlox glaberrima* should read *Phlox glaberrima* var. *melampyrifolia.*

p. 456—insert below **Najas guadalupensis:**

Najas gracillima (A. Br.) Morong. See Rh. **40**: 28. 1938.

Still water of upland pond. Southern Mo., local: Texas Co.

p. 457—**Sagittaria heterophylla** Pursh becomes **Sagittaria rigida** Pursh.

—**Sagittaria heterophylla** var. **elliptica** Engelm. becomes:

Sagittaria rigida f. **elliptica** (Engelm.) Fernald, Rh. **38**: 74. 1936.

—insert below **Lophotocarpus calycinus:**

Lophotocarpus calycinus f. **fluitans** (Engelm.) Steyermark, Rh. **40**: 177. 1938.

Sagittaria calycina var. *fluitans* Engelm.

Lophotocarpus fluitans (Engelm.) J. G. Smith.

In deep water. Southeastern Mo., local: Ste. Genevieve Co.

—**Echinodorus cordifolius** var. **lanceolatus** (Engelm.) Mack. & Bush becomes:

Echinodorus cordifolius f. **lanceolatus** (Engelm.) Fernald, Rh. **38**: 73. 1936.

p. 458—insert below **Bromus purgans:**

Bromus purgans f. **laevivaginatus** Wiegand, Rh. **24**: 92. 1922.

Rarely occurring with the typical form. Ozark Co.

p. 459—**Festuca Shortii** Kunth becomes:
Festuca paradoxa Desv. See Am. Jour. Bot. **24**: 33. 1937.
—insert below **Festuca paradoxa**:
FESTUCA RUBRA L. Red Fescue.
Alluvial shaded waste ground. Introduced in Pulaski Co.
—insert below FESTUCA RUBRA:
FESTUCA RUBRA var. LANUGINOSA Mert. & Koch.
Waste ground. Introduced in St. Louis Co.

p. 460—**Poa Chapmanniana** should read **Poa Chapmaniana.**

p. 463—insert below **Elymus canadensis f. glaucifolius**:
Elymus riparius Wiegand, Rh. **20**: 84. 1918.
Bluffs and rocky wooded slopes along streams. Circumneutral to calciphile. Southeastern Mo.: Butler, Dent, and Shannon counties.

p. 464—**Sitanion hystrix** should read **Sitanion Hystrix.**
—line 9—1935 should read 1933.

p. 466—**Agrostis scabra** Willd. becomes **Agrostis hyemalis** (Walt.) B.S.P.

p. 468, line 16—Rh. **25** should read Rh. **35.**

p. 469—**Sporobolus argutus** (Nees) Kunth becomes:
Sporobolus pyramidatus (Lam.) Hitchc., Man. Grasses W. I., U. S. Dept. Agr. Misc. Publ. 243: 84. 1936.
—insert below **Aristida longespica**:
Aristida longespica var. **geniculata** (Raf.) Fernald, Rh. **35**: 318. 1933.
Open woods and waste ground. Oxylophile. Central and southern Mo.: Moniteau and Butler counties.

p. 470—omit Madison County from enumeration under **Aristida adscensionis.**

p. 472—insert below **Leersia virginica**:
Leersia virginica var. **ovata** (Poir.) Fernald, Rh. **38**: 386. 1936.
This is the common variety in Missouri.
—insert below DIGITARIA ISCHAEMUM:
DIGITARIA ISCHAEMUM var. MISSISSIPPIENSIS (Gattinger) Fernald, Rh. **22**: 103. 1920.
Low ground. Circumneutral. Southern Mo.: Phelps Co.
—**Paspalum repens** Bergius becomes:
Paspalum fluitans Ell. See Rh. **39**: 341, 382, 383. 1937.

p. 474—insert below **Panicum Bicknellii**:
Panicum calliphyllum Ashe.
Rocky open woods. Oxylophile. Southeastern Mo., local: Ripley Co.

p. 475—insert below **Panicum villosissimum**:
Panicum villosissimum var. **pseudopubescens** (Nash) Fernald, Rh. **36**: 79. 1934.
Panicum pseudopubescens Nash.
Rocky wooded slopes. Oxylophile. Southern Mo., local: Miller Co.
—insert below **Panicum malacophyllum**:
Panicum oligosanthes Schultes.
Rocky wooded slopes. Oxylophile. Southern Mo.: Scott, Phelps, Ozark, and Greene counties.

p. 476—insert below **Panicum dichotomiflorum:**

Panicum dichotomiflorum var. **geniculatum** (Wood) Fernald, Rh. **38**: 387. 1936.

Similar situations to the species. General.

p. 477—insert below **Panicum agrostoides:**

Panicum agrostoides var. **ramosius** (Mohr) Fernald, Rh. **38**: 390. 1936.

Panicum elongatum ramosior Mohr.

Similar situations to the typical variety, and the commoner form in Mo.

p. 480—insert below **Manisuris cylindrica:**

Tripsacum dactyloides L. Gama Grass.

Thickets and waste ground. Indifferent. General.

p. 481—**Cyperus esculentus** var. **angustispicatus** Britton becomes:

Cyperus esculentus var. **leptostachys** Boeckl. See Kükenthal in Pflanzenreich **20**: 119. 1936.

p. 482—under **Cyperus filiculmis** omit *Cyperus Bushii* Britton (B. & B.) as a synonym.

—**Kyllinga pumila** Michx. becomes:

Cyperus densicaespitosus Mattf. & Kükenth., Pflanzenr. **20**: 597. 1936.

—**Eleocharis quadrangulata** (Michx.) R. & S., in part, becomes:

Eleocharis quadrangulata var. **crassior** Fernald, Rh. **37**: 393. 1935.

—insert below **Eleocharis quadrangulata:**

Eleocharis equisetoides (Ell.) Torr. See Rh. **31**: 131. 1929.

Eleocharis interstincta of auth., in part, not (Vahl) R. & S. (G.), (B & B).

Swampy margins of pond. Circumneutral. Southern Mo., local: Oregon Co.

p. 483—insert below **Eleocharis acicularis** var. **gracilescens:**

Eleocharis Wolfii Gray.

Low prairie swales. Circumneutral. Northern Mo., local: Linn Co.

p. 484—**Fimbristylis mucronulata** (Michx.) Blake becomes:

Fimbristylis autumnalis var. **mucronulata** (Michx.) Fernald, Rh. **37**: 398. 1935; and insert below this:

Scirpus subterminalis Torr.

Slow or still water of small stream. Calciphile. Southern Mo., local: Oregon Co.

p. 485—under **Scirpus lineatus**, after Circumneutral, insert: to calciphile.

p. 486—*Scleria Elliottii* Chapm., treated under **Scleria ciliata** Michx., becomes:

Scleria ciliata var. **Elliottii** (Chapm.) Fernald, Rh. **39**: 392. 1937.

p. 488—*Carex annectens* var. *xanthocarpa* Wiegand, under **Carex annectens**, should read *Carex annectens* var. *xanthocarpa* (Bickn.) Wiegand.

p. 489—under **Carex brevior** omit *Carex molesta* as a synonym.

—insert below **Carex brevior:**

Carex molesta Mack.

Prairies and meadows. Circumneutral. South-central Mo.: Moniteau and Benton counties.

Carex alata Torr.

Swampy ground. Circumneutral. Southern Mo., local: Oregon and Howell counties.

Carex suberecta (Olney) Britton.

Moist limestone ledges and marly bogs. Circumneutral to calciphile. Eastern Ozark region: Reynolds and Texas counties.

p. 490—insert below **Carex pennsylvanica** var. **digyna:**

Carex communis Bailey.

Wooded rocky slopes. Circumneutral to calciphile. Southwestern Mo.: Taney and Barry counties.

p. 491—insert below **Carex laxiflora:**

Carex gracilescens Steud.

Carex laxiflora var. *gracillima* Boott (G).

Rich woods. Circumneutral. Southeastern Mo., local: Scott Co.

p. 493—insert below **Carex torta:**

Carex substricta (Kükenth.) Mack.

Alluvial banks of streams. Circumneutral. Southeastern Mo., local: Carter Co.

p. 495—insert below **Wolffia papulifera:**

Wolffia punctata Griseb.

In still water of spring-fed lake. Southern Mo., local: Phelps Co.

p. 496—insert below **Tradescantia Ernestiana:**

Tradescantia Ernestiana × **T. ozarkana.** See Contr. Arnold Arb. **9:** 40. 1935.

Occasionally found with the parent species. Southwestern Mo., local: Barry Co.

Tradescantia canaliculata × **T. subaspera.** See Contr. Arnold Arb. **9:** 40. 1935.

Occasionally found with the parent species. Monroe and Franklin counties.

Tradescantia canaliculata × **T. virginiana.** See Contr. Arnold Arb. **9:** 40. 1935.

Sometimes found with the parent species. St. Louis, Jefferson, Butler, and Mississippi counties.

Tradescantia canaliculata × **T. longipes.** See Contr. Arnold Arb. **9:** 41. 1935.

Rarely found with the parent species. Southeastern Mo.: Iron County.

p. 497—**Xyris flexuosa** Muhl. becomes **Xyris torta** Sm.

p. 502—**Camassia hyacinthina** (Raf.) Palmer & Steyermark becomes:

Camassia scillioides (Raf.) Cory, Rh. **38:** 405. 1936.

—insert below **Camassia scillioides:**

Camassia scillioides f. **Petersenii** Steyermark, Rh. **40:** 178. 1938.

Rocky slopes. Calciphile. East-central Mo., local: St. Louis Co.

—SCILLA BIFLORA should read SCILLA BIFOLIA.

p. 503—**Trillium sessile f. luteum** Peattie should read **Trillium sessile f. luteum** (Muhl.) Peattie.

—insert *Trillium sessile* var. *luteum* Muhl. as synonym under **Trillium sessile f. luteum.**

p. 506—**Dioscorea villosa** var. **glabrifolia** (Bartlett) Stone becomes:
Dioscorea villosa f. **glabrifolia** (Bartlett) Fernald, Rh. **39**: 401. 1937.

p. 507—**Iris virginica** of the "Catalogue" becomes **Iris virginica** var. **Shrevei** (Small) Anderson, Ann. Mo. Bot. Gard. **23**: 469. 1936.

p. 508—insert below **Sisyrinchium graminoides**:
Sisyrinchium atlanticum Bicknell.
Sandy open prairie. Oxylophile. Southern Mo.: Scott, Mississippi, and Howell counties.

—**Cypripedium Reginae** should read **Cypripedium reginae**.

p. 510—insert below **Liparis liliifolia**:
Liparis Loeselii (L.) Richard.
Moist meadow. Calciphile. Southeastern Mo., local: Shannon Co.

p. 511—SALIX ALBA var. VITELLINA (L.) Koch should read SALIX ALBA var. VITELLINA (L.) Stokes.

p. 513—insert below POPULUS CANADENSIS var. EUGENEI:
POPULUS CANDICANS Ait. Balm of Gilead.
Escaped from cultivation in Taney Co.
POPULUS TREMULA L. European Aspen.
Escaped from cultivation in Washington Co.

p. 514—insert below **Carya aquatica**:
× **Carya texana** (LeConte) C.DC. See Jour. Arnold Arb. **18**: 133–135. 1937.
Carya aquatica × *C. Pecan.*
Low rich or swampy woods. Circumneutral. Southeastern Mo., local: Dunklin Co.

p. 515—**Carya tomentosa** Nutt. should read **Carya tomentosa** (Lam.) Nutt.

—**Carya tomentosa** var. **subcoreacea** should read **Carya tomentosa** var. **subcoriacea**.

—**Carya glabra** (Mill.) Spach should read **Carya glabra** (Mill.) Sweet.

p. 516—**Carya ovalis** var. **odorata** Sarg. should read **Carya ovata** var. **ovalis** (Marsh.) Sarg.

—**Carya ovalis** var. **obcordata** Sarg. should read **Carya ovalis** var. **obcordata** (Muhl.) Sarg.

—insert below **Ostrya virginiana**:
Ostrya virginiana var. **lasia** Fernald, Rh. **38**: 414. 1936.
With the typical variety. Southern Mo.

—**Ostrya virginiana** var. **glandulosa** (Spach) Sarg. becomes:
Ostrya virginiana f. **glandulosa** (Spach) Macbr., Field Mus. Publ. Bot. **4**: 192. 1929.

p. 517—insert below **Carpinus caroliniana**:
Carpinus caroliniana var. **virginiana** (Marsh.) Fernald, Rh. **37**: 425. 1935.
With the typical variety. Southern Mo.

—insert below **Fagus grandifolia** var. **caroliniana**:
Fagus grandifolia var. **caroliniana** f. **mollis** Fernald & Rehder.
Occurring with **F. grandifolia** var. **caroliniana**. Southeastern Mo.: Bollinger and Wayne counties.

CASTANEA DENTATA (Marsh.) Borkh. Eastern Chestnut.
Well established on cherty dry wooded ridges where persisting from cultivation. Southern Mo.: Howell Co.

p. 519—**Quercus borealis** var. **maxima** Ashe should read **Quercus borealis** var. **maxima** (Marsh.) Ashe.

p. 520—insert below **Quercus leiodermis**:

× **Quercus stelloides** Palmer, Jour. Arnold Arb. **18**: 139. 1937.
Quercus prinoides × *Q. stellata.*
Prairies and glades. Calciphile. Jackson Co.

× **Quercus humidicola** Palmer, Jour. Arnold Arb. **18**: 140. 1937.
Quercus bicolor × *Q. lyrata.*
Low woods. Southeastern Mo.: Dunklin Co.

× **Quercus Schuettei** Trelease.
Quercus bicolor × *Q. macrocarpa.*
Low woods. St. Clair Co.

p. 521, second line from bottom of page—Montieth Junction should read Monteith Junction.

p. 522—insert below **Celtis laevigata** var. **texana**:

Celtis reticulata Torr.
Limestone glade. Calciphile. Western Mo., local: St. Clair Co.

p. 524—insert below **Boehmeria cylindrica**:

Boehmeria cylindrica var. **Drummondiana** Wedd.
Boehmeria cylindrica var. *scabra* Porter (G).
Moist thickets and meadows. Circumneutral. Southeastern Mo., local: Shannon Co.

—insert below Fam. ARISTOLOCHIACEAE:

Asarum canadense L.
Rich woods. Circumneutral. Southwestern Mo.: Taney Co.

p. 527—insert below **Polygonum hydropiperoides**:

- **Polygonum hydropiperoides** var. **Bushianum** Stanford.
Wet meadows. Circumneutral. Southern Mo., local: Howell Co.

p. 529—KOCHIA SCOPARIA should read KOCHIA SCOPARIA.

p. 533—**Iresine paniculata** (L.) Ktze. becomes:

Iresine rhizomatosa Standl., Proc. Soc. Wash. **28**: 172. 1915.

—**Oxybaphus nyctagineus** (Michx.) Sweet becomes:

Mirabilis nyctaginea (Michx.) MacM. See Field Mus. Publ. Bot. **8**: 305. 1931.

—**Oxybaphus floribundus** Chois. becomes a synonym under **Mirabilis nyctaginea.**

Oxybaphus hirsutus (Pursh) Sweet becomes **Mirabilis hirsuta** (Pursh) MacM.

—**Oxybaphus hirsutus** var. **integrifolius** Chois. becomes a synonym under **Mirabilis hirsuta.**

p. 534—**Oxybaphus albidus** (Walt.) Sweet becomes:

Mirabilis albida (Walt.) Heimerl. See Field Mus. Publ. Bot. **8**: 305. 1931.

—**Oxybaphus linearis** (Pursh) Robinson becomes **Mirabilis linearis** (Pursh) Heimerl.

—insert below **Geocarpon minimum:**

TRIANTHEMA PORTULACASTRUM L.

Waste ground. Introduced in Jackson Co.

—add L. after SPERGULA ARVENSIS.

p. 535—insert below **Arenaria patula:**

Arenaria lateriflora L.

Low woods. Circumneutral. Northeastern Mo., local: Scotland Co.

—eleventh line from bottom of page—omit comma between Mouse-ear and Chickweed.

p. 536—insert below **Silene latifolia:**

SILENE CSEREI Baumg.

Waste ground. Introduced in Grundy Co.

p. 537—insert below **Silene stellata:**

Silene stellata var. **scabrella** (Nieuwl.) Palmer & Steyermark, comb. nov.

Evactoma stellata var. *scabrella* Nieuwl., Am. Midl. Nat. 3: 58. 1913.

The common variety in Mo.

—eighth line from bottom of page—Flame Flower should read Fame Flower.

p. 538—**Nymphozanthus advena** (Ait.) Fernald becomes:

Nuphar advena Ait. See Field Mus. Publ. Bot. 8: 310. 1931.

—**Nymphozanthus ozarkanus** (Miller & Standley) Palmer & Steyermark becomes:

Nuphar ozarkana (Miller & Standley) Standley. See Field Mus. Publ. Bot. 8: 310. 1931.

—eighth line from bottom of page—sweet-scented should read Sweet-scented.

p. 539, line 6—Iron County should read St. Francois Co.

—**Ranunculus aquatilis** L. var. **capillaceus** of "Catalogue" and of auth., not DC., becomes:

Ranunculus longirostris Godron. See Rh. 38: 42. 1936.

—**Ranunculus delphinifolius** Torr. becomes:

Ranunculus flabellaris Raf. See Rh. 38: 171. 1936.

—**Ranunculus laxicaulis** (T. & G.) Darby becomes:

Ranunculus ambigens Wats. See Rh. 38: 173. 1936.

p. 540—**Ranunculus fascicularis** Muhl. becomes:

Ranunculus fascicularis var. **apricus** (Greene) Fernald, Rh. 38: 178. 1936.

—**Ranunculus caricetorum** Greene becomes:

Ranunculus septentrionalis var. **caricetorum** (Greene) Fernald, Rh. 38: 177. 1936.

p. 541—insert below RANUNCULUS PARVIFLORUS:

RANUNCULUS BULBOSUS L. Bulbous Buttercup.

Cultivated and waste ground. Introduced in Boone Co.

—insert below **Thalictrum dasycarpum:**

Thalictrum dasycarpum f. **hypoglaucum** (Rydb.) Steyermark, Rh. 40: 178. 1938.

Thalictrum hypoglaucum Rydb.

Sometimes occurring with the typical form. Scattered.

—insert below **Thalictrum revolutum:**

Thalictrum revolutum f. **glabra** Pennell, Bartonia **12**: 12. 1930.

Sometimes occurring with the typical form. Scattered.

—insert below **Anemonella thalictroides:**

Anemonella thalictroides f. **chlorantha** Fassett, Rh. **39**: 461. 1937.

Moist limestone cliffs. Southwestern Mo.: Polk Co.

p. 543—**Delphinium azureum** Michx. becomes **Delphinium carolinianum** Walt. See Rh. **39**: 20. 1937.

—line 10—substitute comma for period between Dent and Shannon.

—**Delphinium azureum** var. **Nortonianum** (Mack. & Bush) Palmer & Steyermark becomes:

Delphinium carolinianum var. **Nortonianum** (Mack. & Bush) Perry, Rh. **39**: 20. 1937.

—insert below **Delphinium carolinianum:**

Delphinium carolinianum var. **crispum** Perry, Rh. **39**: 21. 1937.

Similar situations to the typical form. East-central, middle and southeastern Mo.: St. Charles, Montgomery, Gasconade, Maries, Miller, Morgan, Camden, Laclede, Benton, Dallas, Greene, Taney, Stone, and Barry counties.

—**Delphinium Penardi** Huth becomes:

Delphinium virescens Nutt. var. **Penardi** (Huth) Perry, Rh. **39**: 21. 1937.

p. 545—**Sassafras officinale** Nees & Eberm. becomes:

Sassafras albidum var. **molle** (Raf.) Fernald, Rh. **38**: 179. 1936.

—**Sassafras officinale** var. **albidum** (Nutt.) Blake becomes:

Sassafras albidum (Nutt.)Nees. See Rh. **38**: 179. 1936.

—line 17—substitute comma for period after Dent.

—third line from bottom of page—Mo., local: Atchison Co., should read General. (This is the common variety in Mo.)

p. 548—ERUCASTRUM POLLICHII Spenner becomes:

ERUCASTRUM GALLICUM (Willd.) O. E. Schulz, Engl. Bot. Jahrb. **54**: 56. 1916.

p. 549—DESCURAINIA SOPHIA (L.) Wetts. should read DESCURAINIA SOPHIA (L.) Webb ex Prantl.

—**Descurainia intermedia** (Rydb.) Daniels becomes **Descurainia pinnata** (Walt.) Britton.

p. 550—for **Roripa**, in 9 citations, read **Rorippa.**

p. 551—insert below **Dentaria laciniata** var. **integra:**

Dentaria laciniata var. **latifolia** Farwell, Am. Midl. Nat. **12**: 58. 1930.

Similar situations to the typical form. Southwestern Mo., local: Taney Co.

—insert below **Arabis lyrata:**

Arabis lyrata f. **parvisiliqua** Hopkins, Rh. **39**: 91. 1937.

Similar situations to the typical form. Eastern Ozark region, local: Crawford Co.

—insert below **Arabis dentata:**

Arabis dentata var. **phalacrocarpa** Hopkins, Rh. **39**: 169. 1937.

Similar situations to the typical form. Central and southern Mo.: St. Charles, Jefferson, Saline, St. Clair, and Jasper counties.

p. 552—**Arabis hirsuta** (L.) Scop. becomes **Arabis pycnocarpa** Hopkins, Rh. **39**: 112. 1937.

—insert below **Arabis pycnocarpa**:

Arabis pycnocarpa var. **adpressipilis** Hopkins, Rh. **39**: 117. 1937.

Similar situations to the typical form. Scattered: St. Louis, Shannon, and Taney counties.

—insert below **Arabis viridis**:

Arabis viridis var. **Deamii** Hopkins, Rh. **39**: 157. 1937.

Similar situations to the typical form. Southern Mo., local: Dent Co.

—insert below CLEOME SPINOSA:

Fam. RESEDACEAE

RESEDA LUTEOLA L. Dyer's Weed.

Waste ground. Introduced in Laclede Co.

p. 553—**Heuchera americana** L. becomes:

Heuchera americana var. **interior** Rosendahl, Butters & Lakela, Minn. Stud. Pl. Sci. **2**: 60. 1936.

p. 554—**Heuchera hirsuticaulis** (Wheelock) Rydb. becomes:

Heuchera americana var. **hirsuticaulis** (Wheelock) Rosendahl, Butters & Lakela, Minn. Stud. Pl. Sci. **2**: 60. 1936.

—insert below **Heuchera Richardsonii** var. **Grayana**:

Heuchera Richardsonii var. **affinis**, Rosendahl, Butters & Lakela, Minn. Stud. Pl. Sci. **2**: 124. 1936.

Similar situations to the typical variety. Eastern, central, and southern Mo.: Lewis, St. Louis, Franklin, Phelps, Shannon, Boone, Wright, and Jasper counties.

—omit **Heuchera villosa** Michx.

—**Heuchera macrorhiza** Small becomes:

Heuchera villosa var. **macrorhiza** (Small) Rosendahl, Butters & Lakela, Minn. Stud. Pl. Sci. **2**: 31. 1936.

—under **Mitella diphylla** omit Perry and Howell from enumeration of counties.

p. 555—insert below **Ribes missouriense**:

Ribes missouriense var. **ozarkanum** Fassett, Rh. **39**: 377. 1937.

Similar situations to the typical form. Central and southern Mo. Scattered.

p. 556—under **Physocarpus opulifolius** (L.) Maxim var. **intermedius** (Rydb) Robinson, insert period after Maxim. and after Rydb.

—**Aruncus sylvester** Kostel becomes:

Aruncus allegheniensis Rydb. var. **pubescens** (Rydb.) Fernald, Rh. **38**: 179. 1936.

p. 558—insert below **Crataegus crus-galli** var. **bellica**:

Crataegus crus-galli f. **vulgaris** Rickett, Bot. Gaz. **98**: 613. 1937.

Crataegus crus-galli f. **staminea** Rickett, Bot. Gaz. **98**: 613. 1937.

Crataegus crus-galli f. **spinulosa** Rickett, Bot. Gaz. **98**: 613. 1937.

p. 559—insert as a synonym under **Crataegus Danielsi** Palmer:

Crataegus crus-galli var. *Danielsi* (Palmer) Rickett, Bot. Gaz. **98**: 615. 1937.

p. 562—insert below **Crataegus pruinosa** var. **brachypoda:**

Crataegus pruinosa f. **ciliata** Rickett, Bot. Gaz. **97**: 792. 1936.

Crataegus pruinosa f. **glaberrima** Rickett, Bot. Gaz. **97**: 793. 1936.

Crataegus pruinosa f. **puberula** Rickett, Bot. Gaz. **97**: 793. 1936.

p. 563—under **Crataegus aspera** insert *Crataegus decorata* Sarg. as synonym.

—**Crataegus Kelloggi** should read **Crataegus Kelloggii.**

p. 564—**Crataegus calpodendron** should read **Crataegus Calpodendron** throughout.

p. 566—under **Potentilla paradoxa,** Rocky upland woods, upland prairies and banks of streams, should read: Alluvial ground, mud flats, and banks of streams.

p. 568—insert below **Rubus frondosus:**

Rubus argutus Link.

Low swampy woods. Circumneutral. Southeastern Mo.: Wayne Co.

p. 569, seventh line from bottom—drop "and" after comma.

p. 571—**Rosa carolina** var. **Lyoni** (Pursh) Palmer & Steyermark becomes:

Rosa carolina var. **villosa** (Best) Rehder.

p. 572—ROSA EGLANTARIA should read ROSA EGLANTERIA.

p. 573—**Gymnocladus dioica** (L.) Koch should read **Gymnocladus dioica** (L.) **K.** Koch.

p. 574—**Gleditsia triacanthos** var. **inermis** Pursh becomes:

Gleditsia triacanthos f. **inermis** (Pursh) Fassett, Rh. **38**: 97. 1937.

—**Cassia Medsgeri** Shafer becomes **Cassia marilandica** L. See Rh. **39**: 410–413. 1937.

p. 575—insert below **Cercis canadensis:**

Cercis canadensis f. **glabrifolia** Fernald, Rh. **38**: 234. 1936.

Similar situations to the typical form, and occurring throughout its range.

Cercis canadensis f. **alba** Rehder. See Mo. Bot. Gard Bull. **26**: 82. 1938.

Wooded slopes. Circumneutral. East-central Mo.: Franklin Co. The white redbud was originally described from material received from Teas Nursery Co. of Carthage, Mo., but until recently has not been known to occur in a wild state.

—under **Cladrastis lutea,** insert K. before Koch.

—insert below **Crotalaria sagittalis:**

CROTALARIA RETZII Hitchc.

Fields. Circumneutral. Introduced in Dunklin, Boone, and Saline counties.

p. 576—under TRIFOLIUM PROCUMBENS substitute period for colon after waste ground.

p. 577—**Psoralea pedunculata** (Mill.) Vail becomes:

Psoralea psoralioides (Walt.) Cory var. **eglandulosa** (Ell.) Freeman, Rh. **39**: 426. 1937.

—**Petalostemum purpureum** var. **pubescens** Gray becomes:

Petalostemum purpureum f. **pubescens** (Gray) Fassett, Rh. **38**: 96. 1936.

p. 579—insert below **Amorpha fruticosa** var. **angustifolia:**

Amorpha fruticosa var. **angustifolia** f. **latior** Fassett, Rh. **38**: 190. 1936.

With the typical var. and var. **angustifolia.**

—**Amorpha canescens** var. **glabrata** Gray becomes:
Amorpha canescens f. **glabrata** (Gray) Fassett, Rh. **38**: 191. 1936.
—insert below **Desmodium nudiflorum**:
Desmodium nudiflorum f. **foliolatum** (Farwell) Fassett, Rh. **38**: 189. 1938.
Similar situations to the typical form. Central and southern Mo. Scattered.

p. 581—**Lespedeza Stuevei** var. **angustifolia** Britton becomes:
Lespedeza Stuevei f. **angustifolia** (Britton) Hopkins, Rh. **37**: 265. 1935.

p. 582, line 17—*Lespedeza frutescens* should read *Lespedeza intermedia.*

p. 583—VICIA MICRANTHA should be **Vicia micrantha.**
—insert below **Apios americana**:
Apios americana f. **pilosa** Steyermark, Rh. **40**: 179. 1938.
Similar situations. Scattered in Butler, Texas, and Johnson counties.

p. 584—insert below VIGNA SINENSIS:
GLYCINE MAX (L.) Merr. Soy Bean.
Escaped from cultivation in fields and waste ground. Callaway Co.
—**Amphicarpa comosa** (L.) G. Don becomes:
Amphicarpa bracteata var. **comosa** (L.) Fernald, Rh. **39**: 318. 1937.
—under **Galactea volubilis** var. **mississippiensis** omit Knox from enumeration of counties.

p. 585—insert below **Oxalis violacea**:
Oxalis violacea var. **trichophora** Fassett, Rh. **39**: 378. 1937.
Similar situations to the typical form. East-central Mo.: St. Louis and Jefferson counties.
—insert below **Oxalis europaea** var. **Bushii** f. **subglabrata**:
Oxalis europaea var. **Bushii** f. **vestita** Wiegand, Rh. **27**: 136. 1925.
Occasionally found with the typical forms. Scattered: St. Louis, Ralls, Gasconade, Laclede, and Stone counties.

p. 586—**Linum medium** (Planch.) Britton becomes:
Linum medium var. **texanum** (Planch.) Fernald, Rh. **37**: 428. 1935.

p. 588—**Acalypha virginica** L. becomes **Acalypha rhomboidea** Raf. See Rh. **39**: 16. 1937.
—**Acalypha digyneia** Raf. becomes **Acalypha virginica** L. See Rh. **39**: 16. 1937.

p. 589, second line from bottom of page—under **Euphorbia humistrata** substitute comma for period after Jefferson.

p. 590—insert below **Euphorbia corollata**:
Euphorbia corollata var. **mollis** Millsp.
Limestone glades. Occasionally found with the typical form. Southern Mo.: Phelps, Cole, and Dallas counties.

p. 591—**Rhus Toxicodendron** L. becomes:
Toxicodendron radicans (L.) Ktze. See Ann. Mo. Bot. Gard. **24**: 425. 1937.
—**Rhus quercifolia** (Michx.) Steud. becomes:
Toxicodendron quercifolia (Michx.) Greene. See Ann. Mo. Bot. Gard. **24**: 420. 1937.

—**Rhus canadensis** L. should read **Rhus canadensis** Marsh., and this becomes:

Rhus aromatica Ait. See Ann. Mo. Bot. Gard. **24**: 406. 1937.

—**Rhus canadensis** var. **serotina** (Greene) Palmer & Steyermark becomes:

Rhus trilobata Nutt. var. **serotina** (Greene) Barkley, Ann. Mo. Bot. Gard. **24**: 406. 1937.

—**Rhus canadensis** var. **illinoensis** (Greene) Fernald becomes synonym under **Rhus aromatica** Ait. See Ann. Mo. Bot. Gard. **24**: 406. 1937.

p. 593, line 1—356 should read 256.

—**Acer nigrum** Marsh. should read **Acer nigrum** Michx. f.

—insert below **Acer rubrum** var. **Drummondii**:

Acer rubrum var. **tomentosum** Kirch.

Low wet woods. Oxylophile. Southern Mo.: Wayne Co.

p. 594—**Sapindus Drummondi** should read **Sapindus Drummondii.**

—**Aesculus glabra** var. **pallida** (Willd.) Kirchner becomes:

Aesculus glabra f. **pallida** (Willd.) Fernald, Rh. **39**: 318. 1937.

—insert below **Impatiens pallida**:

Impatiens pallida f. **dichroma** Steyermark, Rh. **40**: 179. 1938.

Wooded slopes. Pike Co.

p. 596—**Ampelopsis arborea** (L.) Rusby should read **Ampelopsis arborea** (L.) Koehne.

p. 598—Malva rotundifolia L. becomes Malva neglecta Wallr. See Rh. **39**: 99. 1937.

p. 599—**Ascyrum hypericoides** L. becomes:

Ascyrum hypericoides var. **multicaule** (Michx.) Fernald, Rh. **38**: 433. 1936.

—insert below the above:

Ascyrum hypericoides var. **oblongifolium** (Spach) Fernald, Rh. **38**: 433. 1936.

Low ground. Oxylophile to circumneutral. Southeastern Mo., local: Dunklin Co.

p. 600—**Hypericum petiolatum** Walt. (not L. nor L. f.) becomes:

Hypericum tubulosum Walt. See Jour. Arnold Arb. **19**: 279. 1938.

Hypericum petiolatum var. *tubulosum* (Walt.) Fernald.

Low ground. Oxylophile to circumneutral. Southeastern Mo., local: Dunklin Co.

—insert after above:

Hypericum tubulosum var. **Walteri** (Gmel.) Lott, Jour. Arnold Arb. **19**: 279. 1938.

Hypericum Walteri Gmel.

p. 603—**Viola papilionacea** × **triloba** becomes × **Viola variabilis** Greene; **Viola sororia** × **triloba** becomes × **Viola populifolia** Greene; **Viola papilionacea** × **sororia** becomes × **Viola napaea** House.

p. 606—after **Ludvigia palustris** (L.) Ell. var. **americana** (DC.) Fernald & Griscom, Rh. **37**: 176. 1935, insert Water Purslane.

p. 607—**Oenothera fruticosa** L. becomes:

Oenothera fruticosa L. var. **vera** Hook. f. **angustifolia** Lévl. See Bull. Torr. Bot. Club **64**: 293–294. 1937.

—**Oenothera hybrida** Michx. becomes:

Oenothera tetragona Roth var. **Fraseri** (Pursh) Munz f. **hybrida** (Michx.) Munz, Bull. Torr. Bot. Club **64**: 300. 1937.

—**Oenothera pratensis** (Small) Robinson becomes:

Oenothera pilosella Raf. See Bull. Torr. Bot. Club **64**: 290. 1937.

—*Oenothera fruticosa* var. *hirsuta* Nutt., synonym under **Oenothera hybrida,** becomes synonym under **Oenothera pilosella.**

p. 610—under **Spermolepis echinata,** after Oxylophile, insert Southern Mo.:

p. 611—insert below **Thaspium barbinode:**

Thaspium trifoliatum (L.) Gray. See Rh. **20**: 52. 1918.

Thaspium aureum Nutt. var. *atropurpureum* (Desv.) Coult. & Rose (G).

Rocky woods. Oxylophile. Southern Mo., local: Laclede Co.

p. 612—under **Cornus florida** f. **rubra** (West) Palmer & Steyermark insert period after West.

p. 613—insert below **Nyssa sylvatica:**

Nyssa sylvatica var. **caroliniana** (Poir.) Fernald, Rh. **37**: 436. 1935.

Similar situations to the typical form. Circumneutral to oxylophile. Southern Mo. This is the commoner variety in Mo.

p. 614, line 21—substitute comma for period after Shannon.

p. 615—**Steironema ciliatum** (L.) Raf. becomes:

Lysimachia ciliata L. See Pflanzenfam. IV. 237: 276. 1905.

—**Steironema radicans** (Hook.) Gray becomes:

Lysimachia radicans Hook. See Rh. **39**: 438. 1937.

—**Steironema lanceolatum** (Walt.) Gray becomes:

Lysimachia lanceolata Walt. See Rh. **39**: 438–441. 1937.

—**Steironema lanceolatum** var. **angustifolium** (Lam.) Gray becomes a synonym under **Lysimachia lanceolata.**

p. 616—**Steironema lanceolatum** var. **hybridum** (Michx.) Gray becomes:

Lysimachia hybrida Michx. See Rh. **39**: 441. 1937.

—**Steironema quadriflorum** (Sims) Hitchc. becomes:

Lysimachia longifolia Pursh. See Pflanzenfam. IV, 237: 279. 1905.

p. 618—insert below **Sabatia angularis:**

Sabatia angularis f. **albiflora** (Raf.) House.

Sometimes occurring with the typical form. Franklin Co.

p. 619—insert below **Frasera carolinensis:**

Menyanthes trifoliata L. var. **minor** Michx. Buckbean. See Rh. **31**: 198. 1929.

Swampy meadows. Calciphile. Southeastern Mo., local: Reynolds Co.

p. 620—**Amsonia Tabernaemontana** var. **salicifolia** Woodson should read **Amsonia Tabernaemontana** var. **salicifolia** (Pursh) Woodson.

p. 621—insert below **Asclepias incarnata:**

Asclepias incarnata f. **albiflora** Heller.

Occasionally found with the typical form. Southern Mo., local: Dallas Co.

—**Asclepias humistriata** should read **Asclepias humistrata.**

p. 622, line 10—*humistriata* should read *humistrata.*

p. 623—**Evolvulus argenteus** Pursh becomes:
Evolvulus Nuttallianus Schultes. See Rh. **37**: 63. 1935.
—**Evolvulus alsinioides** should read **Evolvulus alsinoides.**

p. 625—insert below **Phlox paniculata:**
Phlox paniculata f. **alba** Don. See Bartonia **15**: 25. 1933.
Occasionally found with the typical form. Gasconade Co.
—*Phlox stellata* should read *Phlox Stellaria.*

p. 627, line 21—insert comma after Iron.
—insert above **Heliotropium tenellum:**
COLDENIA NUTTALLII Hook.
Open rocky ground. Introduced in Crawford Co.

p. 628—MYOSOTIS SCIRPOIDES should read MYOSOTIS SCORPIOIDES.

p. 631—insert below **Scutellaria parvula** var. **ambigua:**
Scutellaria parvula var. **australis** Fassett, Rh. **39**: 378. 1937.
Rocky open ground and glades. Central and southern Mo. Scattered.

p. 632—change **Prunella vulgaris** var. **lanceolata** f. **iodacalyx** to f. **iodocalyx.**
—after **Stachys aspera** Michx. add: See Rep. Sp. Nov. Beiheft **80**: 70. 1934.

p. 633—after **Stachys hispida** Pursh add: See Rep. Sp. Nov. Beiheft **80**: 65. 1934.

p. 638—NICOTIANA LONGIFOLIA should read NICOTIANA LONGIFLORA.

p. 639—insert below LINARIA VULGARIS:
Linaria canadensis (L.) Dumont. See Acad. Nat. Sci. Phila. Monogr. **1**: 306. 1935.
Sandy open ground. Oxylophile. Southern Mo.: Dunklin, Iron, and McDonald counties.
—under **Linaria canadensis** (L.) Dumont var. **texana** (Scheele) Pennell, Dumont should read Dumort., and this becomes:
Linaria texana Scheele. See Acad. Nat. Sci. Phila. Monogr. **1**: 302. 1935.
—LINARIA SPURIA (L.) Mill. becomes:
KICKXIA SPURIA (L.) Dumort. See Acad. Nat. Sci. Phila. Monogr. **1**: 313. 1935.
—insert below **Scrophularia marilandica:**
Scrophularia marilandica f. **neglecta** (Rydb.) Pennell, Proc. Acad. Nat. Sci. Phila. **73**: 499. 1921.
Occasionally found with the typical form. General but scattered.
—under **Penstemon pallidus** add as synonym *Penstemon arkansanus* var. *pubescens* Pennell.
last line on page—after Oxylophile to circumneutral, add General.

pp. 639–640—**Pentstemon** in all cases should read **Penstemon.**

p. 640—in enumeration of counties under **Pentstemon arkansanus** omit Madison.
—omit **Pentstemon arkansanus** var. **pubescens** here (see above under page 639).
—insert above **Penstemon Digitalis:**
Penstemon alluviorum Pennell, Acad. Nat. Sci. Phila. Monogr. **1**: 210. 1935.
Low ground. Circumneutral. Southeastern Mo.: Cape Girardeau, Stoddard, Dunklin, and Butler counties.

—after PAULOWNIA TOMENTOSA (Thunb.) Steud., change Empress Tree to Princess Tree.

—insert below **Mimulus alatus:**

Mimulus alatus × **M. ringens.** See Acad. Nat. Sci. Phila. Monogr. **1:** 136. 1935.

Rarely found with the parent species. Southern Mo., local and scattered: Ste. Genevieve, Crawford, Reynolds, Shannon, and Greene counties.

p. 641—**Mecardonia acuminata** (Walt.) Small becomes:

Bacopa acuminata (Walt.) Robinson. See Rh. **37:** 442. 1935.

—**Ilysanthes dubia** (L.) Barnh. becomes, in part:

Lindernia dubia var. **typica** (L.) Pennell, Acad. Nat. Sci. Phila. Monogr. **1:** 141. 1935; and in part—

Lindernia dubia var. **major** (Pursh) Pennell, Acad. Nat. Sci. Phila. Monogr. **1:** 146. 1935.

Both frequently found with the typical var. General.

—**Ilysanthes inaequalis** (Walt.) Pennell becomes:

Lindernia anagallidea (Michx.) Pennell, Acad. Nat. Sci. Phila. Monogr. **1:** 152. 1935.

—insert below **Lindernia anagallidea:**

MAZUS JAPONICUS (Thunb.) Ktze.

Escaped into grassy lawns. Local: St. Louis Co.

—**Gratiola lutea** Raf. becomes:

Gratiola neglecta Torr. See Acad. Nat. Sci. Phila. Monogr. **1:** 84. 1935.

p. 642—insert below **Veronica connata:**

Veronica connata var. **glaberrima** Pennell, Acad. Nat. Sci. Phila. Monogr. **1:** 368. 1935.

Similar situations to the typical form. Southern Mo.: Ripley, Shannon, Texas, Ozark, and Barry counties.

—line 27—*Afzellia macrophylla* should read *Afzelia macrophylla.*

p. 646—insert below **Ruellia strepens:**

Ruellia strepens var. **cleistantha** Gray.

Occasionally found with the typical form. Franklin and Hickory counties.

p. 647—insert above **Galium virgatum:**

SHERARDIA ARVENSIS L. Field Madder.

Open ground. Introduced in McDonald Co.

p. 648—insert below **Galium Aparine** var. **Vaillantii:**

GALIUM VERUM L.

Open ground. Introduced in Adair Co.

—insert below **Galium circaezans:**

Galium circaezans var. **hypomolacum** Fernald, Rh. **39:** 450. 1937.

Occasionally found with the typical form.

—**Galium tinctorium** L. becomes **Galium obtusum** Bigel. See Rh. **37:** 443–445. 1935.

—**Galium Claytoni** Michx. becomes **Galium tinctorium** L. See Rh. **37:** 443–445. 1935.

—insert below **Diodia teres:**

Diodia teres var. **setigera** Fernald & Griscom, Rh. **39:** 307. 1937.

Similar situations to the typical form. Central and southern Mo.

p. 649—**Houstonia patens** Ell. becomes **Houstonia pusilla** Schoepf. Substitute comma for period after Ripley.

p. 650—under **Symphoricarpos occidentalis** omit "and west-central," and Jackson from enumeration of counties.

p. 651—**Viburnum affine** Bush ex Rehder should read **Viburnum affine** Bush ex Schneider.

p. 652—**Valerianella radiata** var. **leiocarpa** becomes a synonym under **Valerianella radiata.** See Rh. **40:** 206. 1938.

—insert below **Valerianella radiata:**

Valerianella radiata var. **missouriensis** Dyal, Rh. **40:** 206. 1938.

Similar situations. Scattered throughout the range.

Valerianella radiata var. **Fernaldii** Dyal, Rh. **40:** 207. 1938.

Low moist ground. Scattered throughout the range.

—insert below **Valerianella stenocarpa:**

Valerianella ozarkana Dyal, Rh. **40:** 208. 1938.

Valerianella longiflora of auth. in part, not (T. & G.) Walp.

Rocky open ground. Calciphile. Southwestern Mo.: Barry and McDonald counties.

—**Valerianella longiflora** of auth. in part becomes:

Valerianella Bushii Dyal, Rh. **40:** 210. 1938.

p. 653—**Specularia biflora** (R. & S.) Fisch. & Mey. should read **Specularia biflora** (R. & P.) Fisch. & Mey.

—insert below **Lobelia cardinalis:**

Lobelia splendens Willd. See Rh. **38:** 259, 277. 1936.

Low ground. Circumneutral. Western Mo., local: Jackson Co.

—insert below **Lobelia siphilitica:**

Lobelia siphilitica var. **ludoviciana** A.DC. See Rh. **38:** 281. 1936.

Similar situations to the typical form. Southern Mo.: Laclede and Greene counties.

—**Lobelia puberula** Michx. becomes **Lobelia glandulosa** Walt. See Rh. **39:** 497. 1937.

p. 654—**Lobelia leptostachys** A.DC. becomes:

Lobelia spicata var. **leptostachys** (A.DC.) Mack. & Bush. See Rh. **38:** 305. 1936.

—under **Vernonia missurica** add *Vernonia interior* var. *Drummondii* (Shuttlw.) Mack. & Bush, as a synonym.

p. 655—**Vernonia interior** Small becomes:

Vernonia Baldwini var. **interior** (Small) Schubert, Rh. **38:** 370. 1936.

—omit **Vernonia interior** var **Drummondii** here (see above under p. 654).

—insert below **Vernonia fasciculata × interior:**

Vernonia fasciculata × missurica.

Occasionally found with the parent species. Lafayette Co.

—**Eupatorium falcatum** Michx. becomes **Eupatorium purpureum** L. See Rh. **39:** 306. 1937.

—**Eupatorium purpureum** of the "Catalogue" becomes:

Eupatorium fistulosum Barratt. See Rh. **39:** 306. 1937.

p. 656—under **Eupatorium coelestinum** substitute Bates Co. for Jackson Co.

p. 657—insert below **Liatris pycnostachya:**

Liatris pycnostachya f. **Hubrichtii** Anderson, Mo. Bot. Gard. Bull. **25:** 122. 1937.

Upland prairies. Circumneutral. Franklin and Grundy counties.

p. 659—**Solidago juncea** var. **scabrella** (T. & G.) Gray becomes:

Solidago juncea f. **scabrella** (T. & G.) Fernald, Rh. **38:** 208. 1936.

—insert below **Solidago juncea** f. **scabrella:**

Solidago neurolepis Fernald, Rh. **38:** 212. 1936.

Dry open woods. Oxylophile. Southwestern Mo.: Jasper Co.

p. 660—insert below **Solidago radula:**

Solidago radula var. **laeta** Fernald, Rh. **38:** 228. 1936.

Similar situations to the typical form. Central and southern Mo.: Pettis and Morgan counties.

Solidago radula var. **stenolepis** Fernald, Rh. **38:** 228. 1936.

Similar situations to the typical form. Southwestern Mo.: Jasper Co.

p. 661—insert below **Solidago Drummondii:**

Solidago Riddellii Frank.

Swampy meadows. Circumneutral. Eastern Ozark region: Dent and Shannon counties.

p. 663—insert below **Aster laevis:**

Aster laevis var. **amplifolius** Porter.

Wooded slopes. Circumneutral. Scattered: Jefferson, Cape Girardeau, Reynolds, Saline, and Atchison counties.

—insert below **Aster ericoides:**

Aster ericoides f. **caeruleus** (Benke) Blake, Rh. **32:** 139. 1930.

Occasionally found with the typical form. Northwestern Mo., local: Clark Co.

p. 664—insert below **Aster lateriflorus** var. **pendulus:**

Aster lateriflorus var. **pendulus** × **A. puniceus** var. **lucidulus.**

Rarely occurring with the parent species. Dent and Shannon counties.

—**Aster paniculatus** var. **bellidiflorus** (Willd.) Burgess becomes a synonym under **Aster paniculatus** Lam. See Rh. **35:** 33. 1933.

—insert below **Aster praealtus** var. **subasper:**

Aster praealtus var. **imbricatior** Wiegand, Rh. **35:** 26. 1933.

Similar situations to the typical form. Greene Co.

p. 665—insert below **Aster interior:**

Aster puniceus L. var. **lucidulus** Gray.

Aster lucidulus (Gray) Wiegand.

Swampy meadows. Calciphile to circumneutral. Eastern Ozark region: Dent, Reynolds, Shannon, and Howell counties.

—line 14—under **Aster ptarmicoides** omit Jackson from enumeration of counties.

—**Pluchea petiolata** Cass becomes:

Pluchea viscida (Raf.) House, Am. Midl. Nat. **7:** 129. 1921.

p. 666—**Antennaria calophylla** Greene becomes:

Antennaria fallax var. **calophylla** (Greene) Fernald. Rh. **38:** 230. 1936.

p. 667—insert below **Silphium integrifolium** the following:

Silphium speciosum Nutt. See Rh. **39**: 286. 1937.

Prairies. Circumneutral. Western Mo.: Jackson, Jasper, Newton, and McDonald counties.

Silphium speciosum var. **Deamii** Perry, Rh. **39**: 287. 1937.

Occasionally found with the typical form. Western Mo.: Jackson Co.

Silphium asperrimum Hook. See Rh. **39**: 286. 1937.

Open ground. Circumneutral. Southeastern Mo., local: Dunklin Co.

Silphium Gatesii Mohr. See Rh. **39**: 288. 1937.

Dry rocky ground. Oxylophile. Southern Mo.: Ripley, Shannon, and Ozark counties.

—**Iva xanthifolia** Willd. should read **Iva xanthifolia** Nutt.

p. 669—**Rudbeckia subtomentosa** var. **Craigii** Sherff becomes:

Rudbeckia subtomentosa f. **Craigii** (Sherff) Fernald, Rh. **39**: 458. 1937.

—insert below **Rudbeckia hirta**:

Rudbeckia hirta f. **homochroma** Steyermark, Rh. **40**: 179. 1938.

Upland woods. Southern Mo., local: Oregon Co.

Rudbeckia hirta var. **sericea** (T. V. Moore) Fernald, Rh. **39**: 457. 1937.

Rudbeckia sericea T. V. Moore.

Frequently found with the typical form. Circumneutral. General.

—under **Rudbeckia missouriensis**, Benton Co. should read Newton Co.

p. 671—insert below **Helianthus mollis**:

Helianthus mollis × **H. occidentalis**.

Dry open ground. Laclede Co.

p. 673—insert below **Coreopsis grandiflora**:

Coreopsis grandiflora var. **Harveyana** (Gray) Sherff, Bot. Gaz. **94**: 593. 1933.

Glades and dry open woods. Oxylophile. Central and southern Mo.: Butler, Wayne, Iron, Carter, Oregon, and Jackson counties.

—**Coreopsis tripteris** var. **Deamii** Standley becomes a synonym under **Coreopsis tripteris** L. See Field Mus. Publ. Bot. **11**: 415. 1936.

p. 674, line 4—Green should read Greene.

p. 676—insert below CHRYSANTHEMUM LEUCANTHEMUM var. PINNATIFIDUM:

CHRYSANTHEMUM PARTHENIUM (L.) Bernh. Feverfew.

Escaped into waste ground. Grundy Co.

p. 677, line 3—*Artemisia vulgaris* subsp. *Wrighti* Hall & Clements should read: *Artemisia vulgaris* subsp. *Wrighti* (Gray) Hall & Clements.

p. 678—insert below CARDUUS CRISPUS:

CARDUUS NUTANS L. Musk Thistle.

Waste ground. Introduced in Jackson Co.

p. 681—LACTUCA SCARIOLA L. should read LACTUCA SERRIOLA L., with *Lactuca scariola* L. as synonym in line below.

—LACTUCA SCARIOLA var. INTEGRATA Gren. & Godr. should read LACTUCA SERRIOLA var. INTEGRATA (Gren. & Godr.) Farwell, Am. Midl. Nat. **10**: 46. 1926, with *Lactuca scariola* var. *integrata* as synonym in line below.

—insert below **Lactuca canadensis** var. **typica**:

Lactuca canadensis f. **angustipes** Wiegand.

Rocky wooded slopes along streams. Circumneutral to oxylophile. Southwestern Mo.: Christian and Taney counties.

CORRECTIONS IN INDEX

p. 687—change *Afzellia macrophylla* to *Afzelia macrophylla.*
p. 689—[American] Brooklime, change 154 to 642.
—[Andropogon] scoparius var. villosissimus should be in italics.
—Angelico, change 610 to 611.
p. 690—[Artemisia] *ludoviciana* should read 676, 677.
p. 691—change [Asclepias] humistriata to humistrata.
p. 692—[Aureolaria] calycosa and flava var. macrantha, change 642 to 643.
p. 693—Black-eyed Susan, change 664 to 669.
—[Bladder-pod] Slender, change 644 to 547.
—[Bladderwort] Large, change 547 to 644.
—Bluets and [Bluets] Small, change 648 to 649.
p. 694—Buck Brush, change 649 to 650.
p. 697—change [Carya] tomentosa var. subcoreacea to tomentosa var. subcoriacea.
p. 698—Cercis canadensis, change 375 to 575.
p. 700—[Clover] Bush should read 581, 582.
p. 701—change [Crataegus] calpodendron to Calpodendron throughout.
p. 702—[Crataegus] Gattingeri, change 562 to 563.
—[Crataegus] Kelloggi should read Kelloggii.
p. 704—Crown-beard, Wild, change to Crown-beard, White.
—insert Curly Muck-weed....................455, below Cuphea petiolata.
p. 705—change [Cypripedium] Reginae to reginae.
p. 706—[Dogwood] Alternate-leaved, Gray, Rough-leaved, Swamp, Stiff, change 612 to 613.
p. 706—[*Dolicholus*] *tomentosus,* change 585 to 584.
p. 707—Tr. Elephant's foot to follow Elephantophus.
—omit Empress Tree.
p. 708—change Evolvulus alsinioides to Evolvulus alsinoides.
—Flame Flower should read Fame Flower, and transpose to follow [False] Starwort.
p. 709—Flax, change 548 to 586.
—insert False....................548, below Flax.
—Fragaria chiloensis var. Ananassa, change 565 to 566.
p. 712—Grindelia lanceolata, change 658 to 657.
p. 713—[Helianthus] divaricatus, change 671 to 670.
—[Helianthus] doronicoides, change 670 to 671.
p. 714—[*Hicoria*] *glabra,* change 514 to 515.
—[*Hicoria*] *microcarpa,* change 514 to 516.
—[*Hicoria*] *villosa* should read 514, 515.
p. 715—[Indian] Bread-root, change 576 to 577.
p. 716—Ironweed, change 634 to 654.
p. 717—[Kochia] scoparia should read Scoparia.
—below [Lactuca] scariola var. integrata, insert:
Serriola 681
Serriola var. integrata.......681
—change Lactuca scariola and Lactuca scariola var. integrata to italics.
p. 718—[Lechea] villosa, change 600 to 601.

p. 720—[Manna Grass] Floating, change 460 to 459.
—[Maple] Sugar, omit 593.
p. 722—change Myosotis scirpoides to Myosotis scorpioides.
—change Nicotiana longifolia to Nicotiana longiflora.
p. 723—[Oenothera] strigosa, change 607 to 606.
—Onosmodium hispidissimum, change 628 to 629.
—[Onosmodium] hispidissimum var. macrospermum, change 628 to 629.
—[Onosmodium] subsetosum, change 628 to 629.
p. 725—[Paspalum] pubescens should be *pubescens*.
p. 726—Change Pentstemon to Penstemon.
—change [Phlox] *stellata* to *Stellaria*.
p. 727—change [Poa] Chapmanniana to Chapmaniana.
p. 728—Pogonia *affinis* should be Pogonia affinis.
p. 729—insert Princess Tree..................640, below Prince's Feather.
p. 730—change [Prunella] vulgaris var. lanceolata f. iodacalyx to f. iodocalyx.
—[Quercus] × *Bebbiana* should be × Bebbiana.
—[Quercus] × Hillii, change 519 to 520.
p. 732—Rhynchosia latifolia, change 584 to 585.
—change Roripa to Rorippa.
—change [Rosa] Eglantaria to eglanteria.
p. 733—[Rubus] villosus should be *villosus*.
—insert strepens....................646, below [Ruellia] pedunculata.
p. 735—Sapindus Drummondi should be Sapindus Drummondii.
—Scilla biflora should read Scilla bifolia.
p. 736—Senecio aureus, change 578 to 678.
—change [Sitanion] hystrix to Hystrix.
p. 737—change Sorrell to Sorrel.
p. 738—[Sphenopholis] *pallens*, change 464 to 465.
p. 740—after Tamaricaceae, Tamarisk, and Tamarix gallica, change 600 to 601.
—Thorough-wax, change 610 to 611.
—[Tobacco] Indian should read 654, 666.
—[Tobacco] Ladies', change 638 to 665.
—[Tobacco] Wild, change 666 to 638.
—Trachelospermum difforme, change 621 to 620.
p. 742—Umbrella-wort should read 533, 534.
p. 744—[Vitis] vulpina var. praecox, change 596 to 597.
—Wild Pansy should read 601, 603.
p. 745—Wolfiella floridana should read Wolffiella floridana.
—[Xanthium] *canadense*, change 669 to 668.
—[Zigadenus] *Nuttallii* should read Nuttallii.

Annals
of the
Missouri Botanical Garden

Vol. 25 NOVEMBER, 1938 No. 4

STUDIES OF SOUTH AMERICAN SENECIOS—II[1]

J. M. GREENMAN

Curator of the Herbarium of the Missouri Botanical Garden
Professor in the Henry Shaw School of Botany of Washington University

The writer is fortunate in having had submitted to him for study relatively large series of undetermined specimens of South American Senecios, both from collections obtained on recent expeditions and also unidentified material of many years standing.

The United States National Herbarium, the New York Botanical Garden, the Field Museum of Natural History, the Gray Herbarium, the Philadelphia Academy of Natural Sciences, the British Museum of Natural History, the Kew Herbarium, the Botanical Garden, Brussells, the Botanical Garden and Museum, Berlin-Dahlem, the Museum of Natural History, Vienna, the Botanical Garden, Geneva, the Botanical Garden, Leiden, and the Botanical Garden, Utrecht, all have generously loaned unnamed material of *Senecio* for study. To those in charge of these herbaria, I extend sincere thanks.

The study of this great assemblage of *Senecio* has made it possible to identify many of the older and little-known species of this vast genus. It has been necessary to reduce to synonymy certain species and varieties, and to describe a few new species. It seems desirable and worth while to place on

[1] Issued November 28, 1938.

record some of the results of this taxonomic research—thus supplementing the paper[1] published fifteen years ago.

For the publication of this paper, I am indebted to Dr. George T. Moore, Director of the Missouri Botanical Garden.

Senecio aberrans Greenm. in Ann. Mo. Bot. Gard. **10**: 73. 1923.

COLOMBIA: "New Granada," Acaña, 10 July, 1845, *Purdie, s.n.* (Kew Hb.).

PERU: near Tarapota, coll. of 1855–56, *R. Spruce, s.n.* (Kew Hb.).

Senecio abietinus Willd. ex Wedd. Chlor. And. **1**: 100. 1855.

COLOMBIA: without definite localities, coll. of 1760–1808, *José Celestino Mutis*, nos. *286, 1785, 3027, 4811* (U. S. Nat. Hb.); Bogotá, Guadeloupe, without date, *Goudot*, no. *1* (Mus. Nat. Hist. Hb., Vienna, and Delessert Hb., Geneva); Bogotá, without date, *Linden*, no. *1250* (Delessert Hb.); Páramo de Usme, coll. of 1922, *Bro. Ariste-Joseph, s.n.* (U. S. Nat. Hb., sheet no. *1122518*).

Senecio adenotrichus DC. Prodr. **6**: 416. 1837; Greenm. in Ann. Mo. Bot. Gard. **10**: 75. 1923.

CHILE: San Felipe, Oct., 1923, and Dec., 1925, *Bro. Claude-Joseph*, nos. *2052* and *3821*, respectively (U. S. Nat. Hb.).

Senecio algens Wedd. Chlor. And. **1**: 104. 1855.

Senecio algens var. *major* Schz. Bip. in Bull. Soc. Bot. Fr. **12**: 80. 1865, name only; Linnaea **34**: 531. 1866, name only.

Senecio algens var. *minor* Schz. Bip. in Bull. Soc. Bot. Fr. **12**: 80. 1865, name only; Linnaea **34**: 530. 1866, name only.

BOLIVIA: vicinity of Sorata, alt. 4500–5000 m., April, 1860, *G. Mandon*, no. *129* (N. Y. Bot. Gard. Hb. and Mus. Nat. Hist. Hb., Vienna), *co-types* of var. *major*; vicinity of Sorata, alt. 3800–3900 m., Jan.–April, 1858, *G. Mandon*, no. *106* (N. Y. Bot. Gard. Hb. and Mus. Nat. Hist. Hb., Vienna), *co-types* of var. *minor*.

[1] Greenman, J. M. Studies of South American Senecios—I. Ann. Mo. Bot. Gard. 10: 73–110, *pls. 3–8.* 1923.

These two varietal names were listed without descriptions, and thus represent *nomina nuda* without nomenclatorial status. A careful examination of duplicate material on which the varieties were founded shows that the plants concerned are merely very slight variations and the names should be merged in synonymy under the species.

Senecio (§ Streptothamni) Andrei Greenm., n.sp.

Frutex scandens glabrus; foliis petiolatis, ovatis vel lanceolato-ovatis, 2.5–5.5 cm. longis, 1–3 cm. latis, mucronato-acutis, remote denticulatis, basi cuneatis vel rotundatis, utrinque glabris, valde reticulato-venosis; inflorescentiis terminalibus; capitulis heterogamis, ca. 1 cm. altis; involucris anguste campanulatis, parce calyculatis; involucri bracteis 8, linearibus vel oblongo-lanceolatis, 4.5–5 mm. longis, glabris apice penicillato excepto, aliquanto venosis; floribus liguliferis 5, ligulis anguste oblongis, ca. 9 mm. longis, 1.5–2 mm. latis, pallido-flavis, tubo gracile, quam pappi setis breviore; floribus disci 15–20, flavis; achaeniis striatis, glabris.

Suffruticose, scandent, glabrous throughout; leaves petiolate, petioles 5–10 mm. long, blade ovate to lanceolate-ovate, 2.5–5.5 cm. long, 1–3 cm. broad, cuneate to rounded at the base, remotely and cartilaginously denticulate, mucronate-acute, glabrous on both surfaces, prominently netted-veined; inflorescence terminal; heads heterogamous, about 1 cm. high; involucre narrowly campanulate, sparingly calyculate; bracts of the involucre 8, linear to oblong-lanceolate, 4.5-5 mm. long, glabrous except at the penicillate tip, rather conspicuously veined; ray-flowers 5, rays narrowly oblong, about 9 mm. long, 1.5–2 mm. broad, pale yellow, tube slender and shorter than the pappus; disk-flowers 15 to 20, yellow; achenes striate, glabrous.

Ecuador: Loja-Zamora, alt. 3000–3500 m., 1 Dec., 1876, *Ed. André*, no. *4520* (Gray Hb., type, Kew Hb.).

This species is most closely related to *S. dictyophlebius* Greenm., from which it differs in having smaller heads, shorter involucral bracts, and a closer mesh of the leaf-venation.

Senecio apiculatus Schz. Bip. ex Wedd. Chlor. And. **1**: 128. 1855.

VENEZUELA: Caracas, coll. of April, 1842, *Linden*, no. *478* (Mus. Nat. Hist. Hb., Vienna, and British Mus. Hb.); Paranadi la Culata, *Moritz*, no. *137* (British Mus. Hb.).

Senecio arboreus (HBK.) Greenm. in Ann. Mo. Bot. Gard. 10: 77. 1923.

Cacalia arborea HBK. Nov. Gen. & Sp. Pl. 4: 163. *pl. 359.* 1820.

COLOMBIA: in mountains near Bogotá, 18 Nov., 1852, *Holton*, no. *247* [*347*] (N. Y. Bot. Gard. Hb.); Delicias, Popoyán, *Lehmann*, no. *B.T. 943* (Gray Hb., Field Mus. Hb., N. Y. Bot. Gard. Hb., and Leiden Hb.); same locality, *Lehmann*, no. *B.T. 946* (Gray Hb. and Leiden Hb.); Caucas, *Lehmann*, no. *B.T. 499* (N. Y. Bot. Gard. Hb.); head-waters of Rio Lopez, Rio Polo Basin, Tierra Adentro, alt. 2500–3000 m., Jan., 1906, *Pittier*, nos. *1083* and *1086* (U. S. Nat. Hb.); Old Quindio Trail, "Magana" to Quindio Pass, Dep't. of Caldas, *Hazen & Killip*, no. *9167* (U. S. Nat. Hb.); "in der oberes Waldregionen an der Östhängen der Central-Andes von Popayán," alt. 2800–3400 m., March–April, *Lehmann*, no. *5203* (Berlin Hb. and British Mus. Hb.).

Senecio arbutifolius HBK. Nov. Gen. & Sp. Pl. 4: 182. 1820.

COLOMBIA: coll. of 1760–1808, *José Celestino Mutis*, no. *648* (U. S. Nat. Hb.).

Senecio argenteus Kunze in Poepp. "Coll. Pl. Chil. 3, p. 192" [Coll. pl. exsic. Chil. 3, no. 192]; DC. Prodr. 6: 415. 1837.

CHILE: without definite locality, *Bertero*, no. *620* (Mo. Bot. Gard. Hb.); Terra Pehuerchium, Dec., 1854, *Lechler*, no. *2893* (Mus. Nat. Hist. Hb., Vienna); Cordillera de Maule, coll. of 1856–1857, *Germain, s.n.* (Mus. Nat. Hist. Hb., Vienna); ash-slope of Volcan Osorno, alt. 200–250 m., 13–15 Feb., 1925, *F. W. Pennell*, no. *12639* (Field Mus. Hb.).

Senecio Aschenbornianus Hieron. in Engl. Bot. Jahrb. 28: 642. 1901.

COLOMBIA: on trees in field, "Canaan," Mt. Purace, Dep't. of El Cauca, alt. 3100–3300 m., *Pennell & Killip*, no. *6509;* same locality, *Killip*, no. *6737* (U. S. Nat. Hb.).

Senecio attenuatus Schz. Bip. in Bull. Soc. Bot. Fr. **12**: 80. 1865, name only; in Linnaea **34**: 531. 1866, name only; Rusby in Mem. Torr. Bot. Club **3**: 63. 1893.

BOLIVIA: La Paz, alt. 3750 m., 24 May, 1906, *O. Buchtien,* no. *73* (N. Y. Bot. Gard. Hb.); La Paz, alt. 3700 m., March, 1913, *O. Buchtien, s.n.* (Mo. Bot. Gard. Hb. and N. Y. Bot Gard. Hb.); La Paz, alt. 3800 m., 18 March, 1919, *O. Buchtien,* no. *380* (Mo. Bot. Gard. Hb.).

The specimens here cited give records of this species in addition to those recorded by Professor Rusby.

Senecio baccharidiflorus Rusby in Bull. N. Y. Bot. Gard. **4**: 397. 1907.

BOLIVIA: Unduavi, Sept., 1894, *M. Bang,* no. *2494* (N. Y. Bot. Gard. Hb.), TYPE; Unduavi, Noryungas, alt. 3300 m., Nov., 1910, *O. Buchtien,* nos. *3041* and *3042* (N. Y. Bot. Gard. Hb.); Gachapata, Aug., 1854, *Lechler,* no. *2608* (Kew Hb.).

Senecio bahioides Hook. & Arn. in Hook. Jour. Bot. **3**: 336. 1841, including *α lanosus* and β. *glaber*.

CHILE: Renca and Quintero, *Bridges,* no. *388* (Mus. Nat. Hist. Hb., Vienna); without definite locality, *Cuming,* no. *618* (Mus. Nat. Hist. Hb., Vienna).

Senecio bogotensis Spreng. Syst. **3**: 556. 1826; DC. Prodr. **6**: 423. 1837.

COLOMBIA: 100 miles northwest of Bogotá, region of La Chapon, State of Boyaca, alt. 4500 ft., 25 July, 1932, *A. E. Lawrance,* no. *356* (Mo. Bot. Gard. Hb.); in forest, Ibaque to Rio Coello, near Quindio Trail, Dep't. of Tolima, 6 Aug., 1912, *Tracy E. Hazen,* no. *9644* (U. S. Nat. Hb.).

Mr. Lawrance states that this plant is a "creeper, height [length] of 40–50 ft., diameter ½–1 inch, flowers red."

Senecio Bowmani R. E. Fries in Ark. för Bot. **5**[18]: 26, *pl. 2, figs. 6–11.* 1906.

ARGENTINA: Tucuman, Prov. of Tucuman, 8 Sept., 1908, *M. Lillo,* no. *8493* (Mo. Bot. Gard. Hb.); Parque, Aconquija, alt. 600 m., 21 Sept., 1917, *R. Schreiter,* no. *73* (Mo. Bot. Gard.

Hb.); Orilla del Basque, 29 Sept., 1924, *Venturi*, no. *2572* (Mo. Bot. Gard. Hb.); Sierra de la Candelaria, alt. 900 m., 6 Sept., 1929, *Venturi*, no. *9471* (Mo. Bot. Gard. Hb.).

Senecio brachycodon Baker in Mart. Fl. Bras. **6**[3]: 319. 1884; Greenm. in Ann. Mo. Bot. Gard. **10**: 78. 1923.

BRAZIL: in wet woods, Itatiaya, State of Rio de Janeiro, alt. 2100 m., 18 March, 1922, *E. W. D. & Mary Holway*, no. *1865* (U. S. Nat. Hb.); in mossy fields above timber line, alt. 2100–2200 m., 30 April–4 May, 1925, *Agnes Chase*, no. *9684* (Mo. Bot. Gard. Hb.).

Senecio brachycodon Baker, *S. myriocephalus* Baker, *S. pellucidinervis* Schz. Bip., and *S. peregrinus* Griseb. constitute a complex which needs further study.

Senecio Brittonianus Hieron. in Engl. Bot. Jahrb. **29**: 72. 1900.

Senecio Sprucei Britton in Bull. Torr. Bot. Club **19**: 265. 1892, not *S. Sprucei* Klatt in Leopoldina **24**: 128. 1887.

PERU: "in montibus Maymensibus prope Tavalosus," July, 1856, *Spruce*, no. *4811* (Kew Hb., TYPE, photograph in Mo. Bot. Gard. Hb.); "prope Tarapota, Peruviae orientales," coll. of 1855–1856, *Spruce*, no. *4811* (Brussels Hb. and Gray Hb.).

BOLIVIA: near Yungas, alt. 4000 ft., coll. of 1885, *Rusby*, no. *1695* (N. Y. Bot. Gard. Hb.); Mapiri, July–Aug., 1892, *Bang*, no. *1513* (N. Y. Bot. Gard. Hb., Phil. Acad. Nat. Sci. Hb., and Mo. Bot. Gard. Hb.); Santa Cruz, alt. 5000 ft., 24 Aug., 1902, *R. S. Williams*, no. *1457* (N. Y. Bot. Gard. Hb.); region of Mapiri, alt. 570–750 m., Sept. and Nov., 1907, *O. Buchtien*, nos. *1559* and *1560* (N. Y. Bot. Gard. Hb.).

Senecio canabinaefolius Hook. & Arn. in Hook. Jour. Bot. **3**: 341. 1841; Greenm. in Ann. Mo. Bot. Gard. **4**: 289. 1917.

ARGENTINA: Cerro de Medina, Prov. of Tucuman, alt. 1600 m., 22 March, 1914, *Lillo*, no. *15976* (Mo. Bot. Gard. Hb.); El Suncha, alt. 2500 m., coll. of 1915, *Jörgensen*, no. *1083* (Mo. Bot. Gard. Hb.); La Hoyata, alt. 1300 m., 14 Dec., 1900, *Lillo*, no. *2611* (Mo. Bot. Gard. Hb.); Puerto Castil., Prov. of Salta, 24 Dec., 1929, *Venturi*, no. *1008* (Mo. Bot. Gard. Hb.).

Senecio chachapoyensis Greenm., n.sp.

Verisimiliter frutex; caulibus lignosis, striatis, fulvo-hirtello-papillosis; foliis alternis, petiolatis, oblongo-lanceolatis, 5–10 cm. longis, 1–3 cm. latis, basi in petiolum sensim angustatis, ad apicem acutis, denticulatis, utrinque glabris, subtus aliquanto pallidioribus conspicue venosisque, nervis lateralibus ab nervo medio latissime divergentibus; petiolis usque ad 1 cm. longis; inflorescentiis terminalibus, paniculatis, multicapitatis; capitulis parvis, ca. 5 mm. altis, homogamis; involucris anguste campanulatis, breviter calyculatis; involucri squamis 8, glabris; floribus disci ca. 10; achaeniis glabris.

Stem ligneous, striate, tawny, hirtellous-papillose; leaves oblong-lanceolate, including the slender petiole 5–10 cm. long, 1–3 cm. broad, narrowed at the base into a petiole (1 cm. or less in length), denticulate, acute, glabrous on both surfaces, somewhat paler and prominently veined beneath, the lateral veins forming almost a right angle with the midrib; inflorescence a terminal many-headed panicle; heads small, about 5 mm. high, homogamous; involucre cylindrical, short-calyculate; bracts of the involucre 8, glabrous; disk-flowers about 10; achenes glabrous.

PERU: "Chacapoyas" [Chachapoyas], coll. of 1835, *Alexander Mathews*, no. *1356* (Kew Hb., TYPE, photograph in Mo. Bot. Gard. Hb.).

The relationship of this species is with *S. theaefolius* Benth., *S. arboreus* (HBK.) Greenm., and *S. chaquiroensis* Greenm. From the first species it differs in having a hirtellous-papillose instead of a glabrous stem; and from the other two species mentioned it differs in having the lateral veins almost at right angles with the midrib.

Senecio (§ Streptothamni) dictyophlebius Greenm., n.sp.

Senecio volubilis Schz. Bip. in Bull. Soc. Bot. Fr. **12**: 80. 1865, name only, and in Linnaea **34**: 531. 1866, name only, not *S. volubilis* Hook.

Frutex scandens; foliis alternis, petiolatis, ovatis vel ovato-oblongis, 2–6 cm. longis, 1.5–4 cm. latis, basi rotundatis vel subcordatis, integris aut crenato-dentatis, ad apicem acutis,

utrinque glabris, subtus pallidioribus et conspicue reticulato-venosis cum venis semipellucidis; petiolis usque ad 1 cm. longis; inflorescentiis terminalibus, subcorymboso-cymosis, paucicapitatis; capitulis heterogamis, radiatis, ca. 10–12 mm. altis; involucris anguste campanulatis, parce calyculatis, glabris; involucri squamis plerumque 8(8–13), linearibus vel lineari-oblongis, 7–8 mm. longis; floribus femineis 8–10, ligulatis, ligulis anguste oblongis, 6–7 mm. longis, flavis; floribus disci 15–20; achaeniis glabris.

Stem scandent, ligneous; leaves alternate, petiolate, ovate to ovate-oblong, 2–6 cm. long, 1.5–4 cm. broad, rounded to subcordate at the base, entire to sparingly crenate-dentate, glabrous on both surfaces, paler and rather conspicuously netted-veined beneath, veins semipellucid; petioles 1 cm. or less in length; inflorescence terminating the stem and branches in few-headed subcorymbose cymes; heads heterogamous, radiate, about 10–12 mm. high; involucre narrowly campanulate, sparingly calyculate, glabrous; bracts of the involucre usually 8 (8–13), linear to linear-oblong, 7–8 mm. long; ray flowers 8–10, rays narrowly oblong, 6–7 mm. long, yellow; disk-flowers 15–20; achenes glabrous.

BOLIVIA: vicinity of Sorata, alt. 3400 m., 31 Dec., 1858, *G. Mandon*, no. *146* (Kew Hb., TYPE, Delessert Hb., Geneva, Brussels Hb., Mus. Nat. Hist. Hb., Vienna, and N. Y. Bot. Gard. Hb., photograph of type in Mo. Bot. Gard. Hb.).

Several collections of this species were made by Mandon in the vicinity of Sorata, Bolivia, at altitudes from 3000 to 3400 meters above sea-level, during the years 1857 to 1859. These plants will be found in many herbaria under the name "*Senecio volubilis* Hooker," and most of them bear the number *146*. *Senecio volubilis* Hooker, however, belongs to quite another natural group of species.

Senecio ellipticifolius Hieron. in Engl. Bot. Jahrb. **28**: 637. 1901.

COLOMBIA: region of Popayán, alt. 2600–3200 m., *F. C. Lehmann*, no. *8508* (Berlin Hb., photograph and fragment in Mo. Bot. Gard. Hb.); S. Antonio, *Ed. André*, no. *K 1293* (Kew Hb.

and N. Y. Bot. Gard. Hb.); Viejes Ocaña, 29 March, 1876, *Ed. André*, no. *K 1294* (Kew Hb.); 100 miles northwest of Bogotá, region of Upper Chapon, state of Boyaca, alt. 6500 ft., 8 Aug., 1932, *Alexander E. Lawrance*, no. *398* (Mo. Bot. Gard. Hb.).

Senecio ellipticus DC. Prodr. **6**: 420. 1837; Mart. Fl. Bras. **6**^{3}: 318. 1884.

Brazil: without specific locality, *collector unknown*, no. *148* (Mo. Bot. Gard. Hb.); Serro do Mar, *Dusén*, nos. *635a* and *10160* (Mo. Bot. Gard. Hb.); Campo Grande, São Paulo, *Brade*, no. *6645* [*Hoehne* no. *6712*] (Mo. Bot. Gard. Hb.); vicinity of Itatiaya, *Rose & Russell*, no. *20542* (U. S. Nat. Hb.).

Senecio eristhalifolius Schz. Bip. ex Baker in Mart. Fl. Bras. **6**^{3}: 321, *pl. 87.* 1884.

Brazil: Juiz de Fóra, Minas Geraes, alt. 700 m., 23 Feb., 1925, *Agnes Chase*, no. *8613* (Mo. Bot. Gard. Hb.).

Senecio evacoides Schz. Bip. in Bonplandia **4**: 55. 1856, name only; Wedd. Chlor. And. **1**: 105. 1855, with description; Gray in Proc. Am. Acad. **5**: 143. 1861.

Peru: "an sommet de Cordillére d'Ayapata, Prov. de Carabaya," alt. 4500 m., *Lechler, s.n.* (Berlin Hb.); Casa Caucha, Alpamarca, alt. 10000–16000 ft., *U. S. Exploring Expedition under command of Capt. Wilkes, s.n.* (U. S. Nat. Hb.); Andes of Peru, alt. 15000 ft., *Lobb, s.n.* (British Mus. Hb.); without definite locality, coll. of 1865–1867, *Richard Pearce, s.n.* (British Mus. Hb.); "Patagonia," *Lobb* (British Mus. Hb.).

Senecio Georgianus Greenm., n. name.

Senecio Hallii Hieron. in Engl. Bot. Jahrb. **21**: 358. 1895, including forma α and forma β, not *S. Hallii* Britt. in Trans. N. Y. Acad. Sci. **9**: 11. 1889.

Ecuador: "Calcitpungo, in Páramo del Alao haud procul ab urbe Riobamba," alt. 4200 m., Nov., 1872, *A. Stübel*, no. *259* (Berlin Hb.).

Senecio Greenmanianus Hieron. in Engl. Bot. Jahrb. **28**: 643. 1901.

Venezuela: Merida, *Moritz*, no. *1384* (Berlin Hb., type,

photograph and fragment in Mo. Bot. Gard. Hb.); Quebrada el Yoyo, Merida, alt. 3800 m., 12 April, 1930, *Gehriger,* nos. *71* and *72* (Mo. Bot. Gard. Hb.); Laguna Mucuy, Merida, alt. 4200–4300 m., 19 April, 1930, *Gehriger,* no. *94* (Mo. Bot. Gard. Hb.); Páramo de Sumusica, State of Táchira, alt. 3100 m., 19 Jan., 1912, *Alfredo Jahn,* no. *51* (U. S. Nat. Hb.); Páramo Quiorá, alt. 3224 m., 8 Oct., 1921, *Alfredo Jahn,* no. *732* (U. S. Nat. Hb.).

Senecio Gürkei Hieron. in Engl. Bot. Jahrb. **28**: 646. 1901.

COLOMBIA: "Nova Granata," *Triana* (Berlin Hb.), TYPE; Mediacion-Quindio, 7 March, 1876, *Ed. André,* no. *2143* (Kew Hb., Field Mus. Hb.).

The André specimen in the Kew Herbarium is accompanied by a field label on which is written the following note: "Arbor cic.—3ⁿ alt. flor. lutei." The species bears some resemblance to *Senecio grandifolius* Less.

Senecio Hillii Greenm., n. sp.

Frutex scandens; caulibus ramisque striatis, floccoso-tomentosis; foliis alternis, petiolatis, lanceolato-ellipticis, 5–10 cm. longis, 2–4.5 cm. latis, obtusis, integris et marginibus revolutis, juventate supra sparse tomentulosis sed mox glabratis, subtus dense et persistenter floccoso-tomentosis; petiolis 5–8 mm. longis; inflorescentiis terminalibus, paniculatis, pluri-capitatis; capitulis heterogamis, subdiscoideis, 10–13 mm. altis; involucris campanulatis, valde calyculatis, bracteolis plerumque 5, elliptico-ovatis, 5–7 mm. longis, 2–3 mm. latis; involucri squamis oblongo-lanceolatis, 6–7 mm. longis, 2–3.5 mm. latis, involucri squamis bracteolisque valde et permanenter tomentosis; capituli floribus exterioribus (10–12) multo reducti, gracilibus, curvatis, inequaliter 3–5-dentatis, dentibus angustis, crassiusculis, obtusis; capituli floribus interioribus ca. 40, corollis tubulo-campanulatis, equaliter 5-dentatis; pappi setis albidis quam corollis disci brevioribus; achaeniis glabris.

Stem scandent, branched, ligneous, striate, floccose-tomentose; leaves alternate, petiolate, lanceolate-elliptic, 5–10 cm. long, 2–4.5 cm. broad, obtuse, entire, revolute-margined,

slightly tomentulose in the early stages but soon glabrate above, densely and permanently floccose-tomentose beneath; petioles 5–8 mm. long; inflorescence a terminal many-headed panicle; heads heterogamous, subdiscoid, 10–13 mm. high; involucre campanulate, conspicuously calyculate with few (about 5) elliptic-ovate 5–7 mm. long and 2–3 mm. broad bracteoles; bracts of the involucre oblong-lanceolate, 6–7 mm. long, 2–3.5 mm. broad, bracts and bracteoles densely and permanently floccose-tomentose; outermost flowers of the head (10–12) reduced, subradiate, corolla tubular, slender, curved, unequally 3–5-dentate, teeth narrow, more or less thickened at the obtuse apex; disk-flowers about 40, corollas tubular-campanulate, equally 5-toothed; pappus white, shorter than the corolla; achenes glabrous.

Ecuador: "in monte Titaicun," alt. 11000 ft., Nov., 1858, *R. Spruce*, no. *5587* (Kew Hb., type, British Mus. Hb., Gray Hb.).

This species has the habit of *Senecio disciformis* Hieron., to which it is evidently closely related, but it differs from that species in having larger and fewer heads, broader involucral bracts and bracteoles, and longer peduncles.

It is a pleasure to name this plant in honor of Sir Arthur W. Hill, Director of the Royal Botanic Gardens, Kew, England.

Senecio Hypsobates Wedd. Chlor. And. 1: 91. 1855.

Colombia: Dep't. of Caldas, Páramo del Quindio, Cordillera Central, alt. 3700–4400 m., 13 Aug., 1922, *Francis W. Pennell*, no. *9804* (U. S. Nat. Hb.); same locality, 15–20 Aug., 1922, *Francis W. Pennell & Tracy Hazen*, no. *10008* (U. S. Nat. Hb.).

A specimen collected at Azufral (probably Colombia) by *Ed. André*, no. *K1291* (N. Y. Bot. Gard. Hb.) is unquestionably also conspecific.

Senecio Klattii Greenm. in Ann. Mo. Bot. Gard. 1: 281. 1914.

S. roseus Klatt in Ann. k.k. Naturhist. Hofmus. Wien 9: 366. 1894, not *S. roseus* Schz. Bip. in Flora 28: 498. 1845.

Peru: without specific locality, *Besser, s.n.* (Berlin Hb., photograph in Mo. Bot. Gard. Hb.); Mt. Tunari, coll. of 1891,

Bang, no. *1046* (N. Y. Bot. Gard. Hb., Phil. Acad. Nat. Sci. Hb., and Mo. Bot. Gard. Hb.).

Senecio Klugii Greenm., n. sp.

Frutex erectus, 3 m. altus; ramis ramulisque brunneis, striatis, albo-tomentulosis; foliis alternis, petiolatis, elliptico-lanceolatis aut elliptico-oblanceolatis, 10–15 cm. longis, 3–6 cm. latis, basi integris cuneatisque, sinuato-serrato-denticulatis, breviter acuminatis, utrinque arachnoideo-tomentulosis, plus minusve glabratis, subtus prominenter venosis; inflorescentiis terminalibus, strictis, paniculato-cymosis; capitulis heterogamis, ca. 12 mm. altis, radiatis; involucris campanulatis, calyculatis; involucri squamis plerumque 13, linearibus vel oblongo-lanceolatis, 6–7 mm. longis, flocculoso-tomentulosis; floribus femineis 10–13, ligulatis, ligulis anguste oblongis, 10–13 mm. longis, flavis; floribus disci 30–40, flavis; achaeniis glabris.

Shrub, 3 m. high; branches brownish, striate, white-tomentulose; leaves petiolate, petioles 5–12 mm. long, leaf-blade obovate-lanceolate to elliptic-lanceolate, 1–1.5 dm. long, cuneate, usually entire towards the base, sinuate-dentate to serrulate towards the acuminate acute apex, arachnoid-tomentulose on both surfaces in the younger stages, more or less glabrate except on the midrib and lateral veins, rather prominently veined beneath; inflorescence a terminal strict paniculate cyme; bracts of the inflorescence linear-attenuate; heads heterogamous, about 12 mm. high, radiate; involucre campanulate, calyculate; bracts of the involucre 13, linear to narrowly oblong-lanceolate, 6–7 mm. long, flocculose-tomentulose; ray-flowers 10–13, rays narrowly oblong, 10–13 mm. long, yellow; disk-flowers 30–40, yellow; achenes glabrous.

Peru: mountain forest, Zepelacio, near Moyobamba, Dep't. of San Martin, alt. 1200–1600 m., Dec., 1933, *G. Klug*, no. *3466* (Mo. Bot. Gard. Hb. and U. S. Nat. Hb.), type; without definite locality, coll. of 1835, *A. Mathews, s.n.* (Kew Hb.).

This species in general habit, particularly in the strict character of the inflorescence, resembles *S. aberrans* Greenm., *S. coroicensis* Rusby, and *S. yungacensis* Britton; but it is readily

distinguished from the first by having a shorter involucre, and from the other two species by characters of the pubescence.

Senecio laricifolius HBK. Nov. Gen. & Sp. Pl. **4**: 185. 1820; DC. Prodr. **6**: 424. 1837.

S. morrensis Hieron. in Engl. Bot. Jahrb. **21**: 362. 1895.

PERU: Dep't. of San Martin, Zepelacio, near Moyobamba, mountain forest, alt. 1200–1600 m., Oct., 1933, *G. Klug*, no. *3279* (Mo. Bot. Gard. Hb.).

Although the writer has not examined the original or type specimen of this species, yet the collection cited above agrees in all details with the published descriptions, and there can be no doubt of the identity.

Senecio ledifolius (HBK.) DC. Prodr. **6**: 421. 1837.

Senecio vernicosus var. *microphyllus* Wedd. Chlor. And. **1**: 94. 1855.

COLOMBIA: Volcan de Tolima, alt. 4000–4300 m., *Linden*, no. *899* (Mus. Nat. Hist. Hb., Vienna); grassy páramo, alt. 4100–4400 m., 15–20 Aug., 1922, *Pennell & Hazen*, no. *9836* (U. S. Nat. Hb.).

Senecio Lindenii Schz. Bip. ex Wedd. Chlor. And. **1**: 101. 1855.

Senecio ledifolius β *Schlimii* Wedd. Chlor. And. **1**: 94. 1855.

COLOMBIA: without definite locality, coll. of 1842, *Linden*, nos. *721*, *735*, and *1248* (Mus. Nat. Hist. Hb., Vienna); without definite locality, *Linden, s.n.* (N. Y. Bot. Gard. Hb.); Bogotá, coll. of 1917, *Bro. Ariste-Joseph*, no. *A 13* (U. S. Nat. Hb.); Guadalupe, near Bogotá, *Bro. Ariste-Joseph*, no. *A.122* (U. S. Nat. Hb.); mountains east of Las Vegas, Dep't. of Santander, alt. 3000–3300 m., 20–21 Dec., 1926, *Killip & Smith*, no. *15823* (Mo. Bot. Gard. Hb.); vicinity of California, alt. 3000 m., 11–27 Jan., 1927, *Killip & Smith*, no. *16906* (Mo. Bot. Gard. Hb.); western slope of Páramo Rico, alt. 3000–3600 m., 15–19 Jan., 1927, *Killip & Smith*, no. *17214* (Mo. Bot. Gard. Hb.); vicinity of Vetas, 16–20 Jan., 1927, *Killip & Smith*, no. *17268* (Mo. Bot. Gard. Hb.); Páramento de las Puentes, above La Baja, alt. 3500–3700 m., 25 Jan., 1927, *Killip & Smith*, no. *18207* (Mo. Bot.

Gard. Hb.); Páramo de las Coloradas, above La Baja, alt. 3000–4100 m., 27 Jan., 1927, *Killip & Smith,* no. *18429* (U. S. Nat. Hb. and Mo. Bot. Gard. Hb.); Páramo de Romeral, alt. 3800–4100 m., 29–30 Jan., 1927, *Killip & Smith,* no. *18561* (U. S. Nat. Hb. and Mo. Bot. Gard. Hb.); La Baja, Prov. of Pamplona, alt. 8000–9000 ft., *Funck & Schlim,* no. *1291* (Brussels Hb.).

Senecio Macbridei Greenm., n. sp.

Herbaceus perennis, arboreus, 1.5 m. altus; ramis fusco-brunneis, aliquanto striatis, sparse hirtellis aut glabris; foliis alternis, petiolatis, oblongo-lanceolatis vel elliptico-lanceolatis, 6.5–15 cm. longis, 2–6 cm. latis, acuminatis, acutis, integris vel paulo dentatis, basi rotundatis vel subcordatis, utrinque glabris, nervis supra leviter canaliculatis subtus prominenter reticulatis; petiolis 0.5–1.5 cm. longis, pubescentibus; inflorescentiis terminalibus axillaribusque, paniculatis; capitulis heterogamis, 12–14 mm. altis; involucris anguste campanulatis, brevi-calyculatis, glabris; involucri squamis 13, lineari-lanceolatis, 7–8 mm. longis, 1–2 mm. latis; floribus femineis 6–8, ligulis ca. 3 mm. longis, flavis; floribus disci 12–15; achaeniis glabris.

Shrub or stout herb, 1.5 m. high; branches reddish-brown, somewhat striate, sparingly hirtellous to glabrous; leaves alternate, petiolate, oblong-lanceolate to elliptic-lanceolate, 6.5–15 cm. long, 2–6 cm. broad, acuminate, acute, entire to sparingly denticulate, rounded to subcordate at the base, glabrous on both surfaces, veins sunken above, prominently and strongly reticulated beneath; petioles 0.5–1.5 cm. long, pubescent; inflorescence in terminal and axillary panicles; heads heterogamous, 12–14 mm. high; involucre narrowly campanulate, short-calyculate, glabrous; bracts of the involucre about 13, linear-lanceolate, 7–8 mm. long, 1–2 mm. broad; ray-flowers 6–8, rays short, about 3 mm. long; disk-flowers 12–15; achenes glabrous.

PERU: in shrubs along gravelly stream-course, La Merced, alt. about 2000 ft., 10–24 Aug., 1923, *J. Francis Macbride,* no. *5254* (Field Mus. Hb. and Mo. Bot. Gard. Hb.), TYPE.

This species resembles *Senecio semidentatus* Klatt, to which it is unquestionably closely related; it differs, however, in hav-

ing longer and more slender petioles, narrower involucral bracts, shorter bracteoles, and smaller ray-flowers.

Senecio magellanicus Hook. & Arn. in Hook. Jour. Bot. **3**: 343. 1841.

Culcitium magellanicum Hombr. & Jacquem. ex Decne. Bot. Voy. Astrol. et Zél., p. 43. 1853; D'Urville, Voy. Pole Sud. & Océanie, Atlas, Dicot., *t. 11, figs. X.* 1852.

ARGENTINA: "Terres Magellanique," *Lechler* [*A. Lenormand mis.* 1857] (Mo. Bot. Gard. Hb.); Punta Arenas, 10 Feb., 1857, *Lud. Savatier,* no. *82* (Kew Hb.).

Senecio Magnusii Hieron. in Engl. Bot. Jahrb. **28**: 642. 1901; Greenm. in Ann. Mo. Bot. Gard. **10**: 85. 1923.

COLOMBIA: without specific locality, coll. of 1892, *Triana,* no. *1486* (Berlin Hb., TYPE, fragments and photograph in Mo. Bot. Gard. Hb.); mountain east of Las Vegas, alt. 3000–3330 m., 20–21 Dec., 1926, *Killip & Smith,* no. *15781* (Mo. Bot. Gard. Hb.).

Senecio melanolepis DC. Prodr. **6**: 424. 1837; Wedd. Chlor. And. **1**: 130. 1855.

This little-known species appears to be well marked by the linear to linear-lanceolate revolute-margined leaves, the radiate heads, and conspicuously black-tipped bracts of the inflorescence, and of the bracts and bracteoles of the involucre. It is well represented by two specimens in the Kew Herbarium which bear the label, "Peruvia. Herb. Pavon. Comm. W. Barbey 7/1888." These specimens agree in all essential details with the original description by De Candolle, and with Weddell's characterization of the species.

Senecio Millei Greenm., n.sp.

Verisimiliter frutex; caulibus foliaceis, brunneis, striatis, juventate floccoso-tomentulosis, denique plus minusve glabratis; foliis crebris, alternis, petiolatis, elliptico-ovatis, 3.5–6 cm. longis, 1.5–3 cm. latis, mucronato-acutis, calloso-denticulatis, utrinque floccoso-tomentulosis, plus minusve glabratis, atro-viridibus et crebre reticulato-venosis, venis lateralibus subtus arcuato-connatis; inflorescentiis terminalibus, thyr-

soideo-paniculatis, multi-capitatis; capitulis 5–6 mm. altis, homogamis; involucris campanulatis, calyculatis; involucri bracteis 8, ca. 3.5 mm. longis, flocculoso-pubescentibus, aliquanto glabratis; floribus disci 12–15; achaeniis glabris.

Suffruticose; stem leafy, brownish, striate, floccose-tomentulose, more or less glabrate; leaves crowded, petiolate, elliptic-ovate, 3.5–6 cm. long, 1.5–3 cm. broad, mucronate-acute, rather closely cartilaginous-denticulate, floccose-tomentulose on both surfaces, more or less glabrate, dark green, closely reticulate-veined, lateral veins prominent and conspicuously arcuate-anastomose beneath; inflorescence a terminal many-headed thyrsoidal panicle; heads sessile, small, 5–6 mm. high, homogamous; involucre campanulate, calyculate; bracts of the involucre 8, about 3.5 mm. long, lightly flocculent-pubescent, more or less glabrate; flowers discoid, 12–15; achenes glabrous.

ECUADOR: Loja, coll. of Aug., 1847, *Seemann, s.n.* (Kew Hb.), TYPE.

This species is named in honor of Rev. Father Luis Mille, a distinguished botanist of Ecuador; it is related to *Senecio theaefolius* Benth., from which, however, it differs in having a more pronounced reticulate leaf-venation, shorter involucral bracts, and a flocculent tomentum on stem and leaves.

Senecio Millei suggests also a relationship with *S. Brittonianus* Hieron., particularly in the characters of the inflorescence and tomentum; but it differs in having smaller and discoid instead of radiate heads, smaller and distinctly denticulate leaves with a close but conspicuous leaf-venation.

Senecio modestus Wedd. Chlor. And. **1**: 105, *pl. 18, fig. B.* 1855.

BOLIVIA: without specific locality, *Bang*, no. *1890* (Mo. Bot. Gard. Hb., Phil. Acad. Nat. Sci. Hb., Gray Hb., U. S. Nat. Hb., Mus. Nat. Hist. Hb., Vienna); near Luipichi, 9 Sept., 1901, *R. S. Williams*, no. *836* (N. Y. Bot. Gard. Hb.).

PERU: Viso, in shallow soil, on rocks, alt. 9000 ft., 5–14 May, 1922, *Macbride & Featherstone*, no. *610* (Field Mus. Hb.).

Senecio nevadensis Schz. Bip. ex Wedd. Chlor. And. **1**: 97. 1855.

VENEZUELA: Páramo de la Culata, *Moritz,* no. *1383* (Bot. Mus. Hamburg Hb.); Michuntuy, Culata Range, Merida, alt. 4000 m., 17 Dec., 1910, *Alfredo Jahn,* no. *131a* (U. S. Nat. Hb.).

Senecio octophyllus Schz. Bip. in Linnaea **34**: 531. 1866, name only; Rusby in Bull. N. Y. Bot. Gard. **4**: 393. 1907, with description.

Senecio olophyllus Schz. Bip. in Bull. Soc. Bot. Fr. **12**: 80. 1865, name only.

BOLIVIA: vicinity of Sorata, alt. 3400–3900 m., Feb.–March, 1859, *Mandon,* no. *118* (N. Y. Bot. Gard. Hb.); without definite locality or date of collection, *Bang, s.n.* (N. Y. Bot. Gard. Hb.).

PERU: Nevado de Chachani, Dep't. of Arequipa, rock-clefts in open valley, alt. 4100–4200 m., April, 1925, *Pennell,* no. *13296* (Field Mus. Hb.).

The name originally ascribed to Mandon's no. *118* by Schultz Bipontinus in the 'Bulletin de la Société Botanique de France' in 1865 was *"Senecio olophyllus";* but no description of it was given. In 'Linnaea' of 1866, Mandon's no. *118* was listed as *"Senecio octophyllus,"* again without description.

The change of specific name was probably due to a typographical error, since the plant is very leafy and the leaves are densely whitish tomentose. The original specific name was doubtless intended to carry the connotation of *silver-leaved,* not *eight-leaved.* However, the combination *Senecio octophyllus* was validated through the publication of a description by Professor Rusby in the 'Bulletin of the New York Botanical Garden' in 1907; thus, in accordance with present rules of botanical nomenclature, *Senecio octophyllus* becomes the correct binomial for this plant, and the original name *"Senecio olophyllus"* falls to synonmy, as a *nomen nudum.*

Senecio pachypus Greenm., n.sp.

Frutex; cauli tereti, aliquanto irregulariter sed plus minusve di–trichotomoso-ramoso, juventate fulvo-hirsuto deinde glabrato sed subcicatricoso; foliis crebris, brevi-petiolatis, oblongo vel oblongo-ellipticis, 5–10 mm. longis, 3–6 mm. latis, obtusis, proxime et regulariter crenato-dentatis, in sinis marginatis foliorum paululo pubescentibus, basi in petiolum subito

contractis, utrinque glabris, supra plus minusve lucidis, subtus livido-viridibus; petiolis usque ad 2 mm. longis, subcoriaceis et persistentibus; inflorescentiis terminalibus, corymboso-cymosis, pauci-capitatis; capitulis heterogamis, radiatis; involucris campanulatis, calyculatis, bracteolis subcoriaceis ciliatisque; involucri squamis plerumque 13, lineari-lanceolatis, 4–5 mm. longis; floribus femineis ligulatis, ca. 8, ligulis pallide flavis; floribus disci 20–22; achaeniis glabris.

Shrub; stem somewhat irregularly branched, more or less di–trichotomous, tawny-pubescent with coarse stiff hairs, slightly roughened by the persistent cartilaginous-thickened remains of the petioles; leaves crowded, short-petiolate, oblong to oblong-elliptic, 5–10 mm. long, 3–6 mm. broad, obtuse, closely and regularly crenate-dentate, abruptly contracted at the base into a relatively broad 1–2 mm. long petiole, glabrous except for tufts of minute dark hairs in the leaf-sinuses and scattered hairs on the sunken midrib, more or less lucid above, dull green beneath; inflorescence terminating the stem and branches in few-headed round-topped corymbose cymes; heads heterogamous, radiate; involucre campanulate, calyculate with rather broad thickish ciliolate bracteoles; bracts of the involucre 13, linear-lanceolate, 4–5 mm. long; ray-flowers 8, rays lemon yellow; disk-flowers 20–22; achenes glabrous.

VENEZUELA: in Colorado forest, Páramos de Laguna Grande, Merida, 21 Jan., 1929, *H. Pittier*, no. *13243* (Mo. Bot. Gard. Hb., TYPE); Páramo Quirorá, alt. 3200 m., 9 Oct., 1921, *Alfredo Jahn*, no. *709* (U. S. Nat. Hb.); Páramo del Molino, Merida, alt. 2600 m., *Alfredo Jahn*, no. *953* (U. S. Nat. Hb.); "entre las Lagunas El Yoho y de Barrios," alt. 4000–4150 m., Merida, 19 April, 1930, *Gehriger*, no. *88* (Mo. Bot. Gard. Hb.); Páramo de Tuñame, alt. 3280 m., 24 Nov., 1910, *Alfredo Jahn*, no. *60* (U. S. Nat. Hb.).

The last specimen cited has more or less ciliated leaves; but it probably represents only a slight variation of the species.

Senecio Pampae Lingelsheim in Fedde, Rep. Nov. Sp. **8**: 6. 1910.

BOLIVIA: Pazna, 18½° S. latitude, alt. 4000 m., May, 1908,

Otto Buchtien, no. *1582* (Berlin Hb., N. Y. Bot. Gard. Hb., fragment and photograph Mo. Bot. Gard. Hb.); near summit of pass, Oruro-Cochabamba Railway, 16 March, 1920, *E. W. D. & Mary Holway,* no. *414* (U. S. Nat. Hb.); Cuchichanchi, alt. 3200 m., 21 July, 1929, *José Steinbach,* no. *9873* (Mo. Bot. Gard. Hb.).

ARGENTINA: Maimara, Prov. of Jujuy, 20 Jan., 1906, *ex Hb. Lillo,* no. *4917* (Mo. Bot. Gard. Hb.); between rocks, Prov. of Tucuman, alt. 3200 m., 4 April, 1901, *Lillo, s.n.* (Mo. Bot. Gard. Hb.); Olfarcito, Prov. of Jujuy, alt. 2650 m., 30 Sept., 1925, *Pereyra,* no. *5825* (Mo. Bot. Gard. Hb.).

Senecio pellucidinervis Schz. Bip. ex Baker in Mart. Fl. Bras. **6**^{3}: 319. 1884; Greenm. in Ann. Mo. Bot. Gard. **10:** 88. 1923.

BRAZIL: Campos do Jordão, *Löfgren* [*Hoehne*], no. *16955* (Mo. Bot. Gard. Hb.); Campos do Jordão, Sierra Mantiquera, São Paulo, 20–22 May, 1925, *Agnes Chase,* no. *9884* (Mo. Bot. Gard. Hb.); Itatiaya, *Brade & Tomandari,* no. *6390* [*Hoehne,* no. *6280*] (Mo. Bot. Gard. Hb.).

Senecio pensilis Greenm., n. sp.

Herbaceus perennis, ubique albo-tomentosis; caulibus gracilibus, 2–6 dm. longis, plus minusve pendentibus, ad apicem aliquanto ascendentibus; foliis alternis, petiolatis, lanceolato-ovatis, 1–3.5 cm. longis, 0.5–2 cm. latis, basi cuneatis vel subtruncatis, subintegris aut dentatis, acutis, supra arachnoideo-tomentulosis, subtus dense albo-tomentosis; petiolis gracilibus paulo marginatisque, 0.5–1.5 cm. longis, basi frequenter inconspicueque aliquanto amplexicaulibus; inflorescentiis terminalibus, longi-pedunculatis, plus minusve nutantibus, corymboso-cymosis; capitulis ca. 1 cm. altis, heterogamis, ligulatis; involucris calyculatis; involucri squamis ca. 21, ad apicem subglabris purpurascentibusque, ceteris albo-tomentosis; floribus femineis ca. 8, ligulis flavis; floribus disci 40–60; achaeniis glabris.

Suffruticose, white-tomentose throughout; stems slender, 2–6 dm. long, more or less pendent, somewhat ascending at the tips; leaves petiolate, lanceolate-ovate, 1–3.5 cm. long, 0.5–2

cm. broad, cuneate to subtruncate at the base, subentire to dentate, acute, arachnoid-tomentulose above, densely white-tomentose beneath; petioles slender and slightly margined by the decurrence of the leaf-blade, 0.5–1.5 cm. long, often inconspicuously auriculate and somewhat amplexicaul at the base; inflorescence terminating the stem and branches on nearly naked long-pedunculate more or less nodding corymbose cymes; heads about 1 cm. high, heterogamous, radiate; involucre çalyculate; bracts of the involucre about 21, white-tomentulose except at the purplish tip; ray-flowers about 8, rays yellow; disk-flowers 40–60; achenes glabrous.

BOLIVIA: "Pelechuco," alt. 12000–14000 ft., March and May, 1865, *R. Pearce, s.n.* (Kew Hb., TYPE, British Mus. Hb.).

PERU: Vilcacota, July, 1833, *Alexander Mathews,* no. *1131* (Kew Hb.); Rio Blanco, alt. 15000 ft., May 8–19, 1922, *Macbride & Featherstone,* no. *796* (Field Mus. Hb.).

According to Macbride and Featherstone, this plant grows in a rather unusual habitat, namely, "pendant from canyon rock crevices."

Senecio pericaulis Greenm. in Ann. Mo. Bot. Gard. **10**: 89. 1923.

In addition to the specimens recorded in the above publication, the following collections are referred to this species:

ECUADOR: hills near Cuenca, date of collection not indicated, *Jameson,* no. *26* (Kew Hb.); base of Pilzheim, alt. 12000 ft., without date, *Jameson, s.n.* (Kew Hb.); Pichincha, alt. 13000 ft., *Jameson, s.n.* (Mus. Nat. Hist. Hb., Vienna, sheet no. *122720*).

Senecio pichinchensis Greenm., n.sp.

Frutex; ramis ramulisque juventate hirsuto-pubescentibus, denique aliquod glabratis; foliis alternis, petiolatis, oblongo-ovatis aut subrotundatis, 5–10 mm. longis, 3–10 mm. latis, apici obtusis aut rotundatis, 3–5-crenato-dentatis, plus minusve revoluto-marginatis, utrinque glabris, subcoriaceis, nervo medio et nervis lateralibus supra depressis, subtus prominulis; petiolis 1–2 mm. longis, basi plus minusve persistentibus; inflores-

centiis terminalibus, paniculato-cymosis; capitulis heterogamis, 10–12 mm. altis, radiatis; involucris campanulatis, conspicue bracteolatis, bracteolis linearibus, patentibus; involucri squamis plerumque 13, lineari-lanceolatis, ca. 6 mm. longis, extrinsecus glabris, apici penicillatis; floribus femineis 8, ligulatis, ligulis anguste oblongis, ca. 7 mm. longis, 2–2.5 mm. latis, flavis; floribus disci 13–16; achaeniis glabris.

Shrub; stem and branches in the earlier stages hirsute-pubescent, later somewhat glabrate; leaves alternate, petiolate, oblong-ovate to subrotund, 5–10 mm. long, 3–10 mm. broad, obtuse or rounded at the apex, crenate-dentate with few (3–5) blunt teeth, more or less revolute-margined, glabrous on both surfaces, thick in texture, midvein and lateral nerves sunken above, distinct beneath; petioles 1–2 mm. long, base more or less persistent; inflorescence terminating the stem and branches in rather leafy paniculate cymes; heads heterogamous, radiate, 10–12 mm. high; involucre campanulate, conspicuously bracteolate, bracteoles linear, spreading; bracts of the involucre 13, linear-lanceolate, about 6 mm. long, glabrous except the penicillate tip; ray-flowers 8, rays narrowly oblong, about 7 mm. long, 2–2.5 mm. broad, yellow; disk-flowers 13–16; achenes glabrous.

ECUADOR: ravines, western slope of Pichincha, alt. 13000 ft., without date of collection, *W. Jameson,* no. *24* (British Mus. Hb., TYPE, Mus. Nat. Hist. Hb., Vienna, and U. S. Nat. Hb.); near Quito, alt. 12000 ft., without date of collection, *W. Jameson, s.n.* (British Mus. Hb.).

Senecio pimpinellaefolius HBK. Nov. Gen. & Sp. Pl. **4**: 174. 1820.

PERU: Chachapoyas, coll. of 1837, *Mathews,* no. *3054* (British Mus. Hb. and Brussels Hb.).

Senecio polyphyllus Kunze in Poepp. "Coll. Pl. Chile 3, no. 196" [Coll. pl. exsic. Chil. 3, no. 196]; DC. Prodr. **6**: 415. 1837.

PERU: Cuajones Mine, Torata, Prov. of Moquegua, 10 Feb., 1925, *Weberbauer,* no. *7466* (Field Mus. Hb. and Mo. Bot. Gard. Hb.).

CHILE: Pico de Pilque, Andes de Antuco, *Poeppig,* no. *196* (British Mus. Hb.); southern Andes, 8 Dec., 1828, *Poeppig, s.n.* (Mo. Bot. Gard. Hb.).

Senecio praeruptorum Schz. Bip. in Bull. Soc. Bot. Fr. **12:** 80. 1865, name only; Linnaea **34:** 530. 1866, name only; Klatt in Leopoldina, Heft 24, p. 127. 1888, with description.

BOLIVIA: vicinity of Sorata, alt. 3300–3600 m., 8 April, 1858, *G. Mandon,* no. *115* (N. Y. Bot. Gard. Hb.); Pelechuco, alt. 12000 ft., March, 1865, *R. Pearce* (Kew Hb.).

Senecio pulchellus (HBK.) DC. Prodr. **6:** 421. 1837; Wedd. Chlor. And. **1:** 100. 1855.

Cacalia pulchella HBK. Nov. Gen. & Sp. Pl. **4:** 160. 1820.

COLOMBIA: without specific locality, coll. of 1842, *Linden,* no. *1251* (Mus. Nat. Hist. Hb., Vienna); Norte de Santander, road from Pamplona to Toledo, crossing the divide between La Teja (Maracaibo drainage) and Rio Mesme (Orinoco drainage), alt. 2500–2800 m., 28 Feb., 1927, *E. P. Killip & Albert C. Smith,* no. *19912* (Mo. Bot. Gard. Hb.); without specific locality, coll. of 1760–1808, *José Celestino Mutis,* nos. *243, 1824,* and *4863* (U. S. Nat. Hb.).

Senecio rhizomatus Rusby in Mem. Torr. Bot. Club **6:** 66. 1896, excluding *Bang,* no. *1046.*

S. erosus Wedd. Chlor. And. **1:** 228. 1855; Bull. Soc. Bot. Fr. **12:** 80. 1865; Linnaea **34:** 530. 1866, not *S. erosus* Linn f. Suppl. p. 370. 1781.

BOLIVIA: near snow line, Mt. Tunari, coll. of 1891, *Bang,* no. *1050* (N. Y. Bot. Gard. Hb., Phil. Acad. Nat. Sci. Hb., Mo. Bot. Gard. Hb., and Mus. Nat. Hist. Hb., Vienna), type collection of *S. rhizomatus* Rusby; vicinity of La Paz, alt. 5000 ft., 15 April, 1857, *Mandon,* no. *114* (N. Y. Bot. Gard. Hb.), type collection of *S. erosus* Wedd.; vicinity of Sorata, alt. 3300–4500 m., 8 Feb., 1858, *Mandon,* no. *114* (N. Y. Bot. Gard. Hb.).

Bang's no. 1046, mentioned by Rusby, *l.c.,* is *Senecio Klattii* Greenm.

Senecio Richii Gray in Proc. Am. Acad. **5:** 142. 1861.

PERU: Obrajillo, *U. S. Exploring Exp. under command of Capt. Wilkes, s.n.* (U. S. Nat. Hb.); open rocky slope, Canta,

Dep't. of Lima, alt. 2800–2900 m., 11–19 June, 1925, *Francis W. Pennell*, no. *14578* (Field Mus. Hb., Mo. Bot. Gard. Hb.); open rocky slopes, along Rio Chillón, above Obrajillo, Dep't. of Lima, 13–23 June, 1925, *Francis W. Pennell*, no. *14380* (Field Mus. Hb. and Mo. Bot. Gard. Hb.).

Senecio Richii Gray var. **latior** Greenm., n. var.

S. Richii var. β. Gray in Proc. Am. Acad. 5: 142. 1861.

Formae typicae habitu simili; foliis superioribus subpinnatisectis vel laciniatis, supra glabris, subtus arachnoideo-tomentulosis; laciniis foliorum lineari-acuminatis, usque ad 1 cm. longis, acutis, plus minusve curvatis.

Similar to the species, but with less pinnatisect leaves and broader leaf-lobes, more or less white arachnoid-tomentulose on the under leaf-surface.

PERU: Obrajillo, *U. S. Expl. Exp. under command of Capt. Wilkes, s.n.* (U. S. Nat. Hb., sheet no. *1121675*), TYPE.

Senecio scaphiformis Greenm., n.sp.

Frutex, usque ad 5 m. altus; caulibus fusco-brunneis, striatis, tomentuloso-pubescentibus; foliis alternis, petiolatis, ovatis vel ovato-oblongis, 6–12 cm. longis, 4–6.5 cm. latis, basi cuneatis vel rotundatis, sinuato-dentatis, acutis, supra glabris vel subglabris, subtus sparse crispo-pubescentibus et conspicue venosis; petiolis 0.5–2 cm. longis; inflorescentiis paniculatis terminalibus; inflorescentiae bracteis foliaceis, subpetiolatis, obovatis, plus minusve scaphiformibus et aliquanto suffultis; capitulis heterogamis, radiatis, 10–12 mm. altis; involucris anguste campanulatis, calyculatis; involucri squamis 8, lineari-lanceolatis, ca. 7 mm. longis, flocculoso-tomentulosis; floribus femineis 8, ligulis anguste oblongis, ca. 8 mm. longis, 4-nervatis, flavis; floribus disci 10–12; achaeniis glabris.

Shrub 5 m. or less high; branches reddish-brown, striate, minutely pubescent; leaves alternate, petiolate, ovate to ovate-oblong, 6–12 cm. long, 4–6.5 cm. broad, cuneate to rounded at the base, sinuate-dentate, acute, glabrous or nearly so above, sparingly pubescent beneath, prominently veined; petioles 0.5–2 cm. long; inflorescence a terminal panicle; bracts of the inflorescence foliaceous, subpetiolate, obovate, more or less boat-

shaped and somewhat suffultous; heads heterogamous, radiate, 10–12 mm. high; involucre narrowly campanulate, calyculate; bracts of the involucre 8, linear-lanceolate, about 7 mm. long, flocculose-tomentulose; ray-flowers 8, rays narrowly oblong, about 8 mm. long, 4-nerved, yellow; disk-flowers 10 to 12, yellow; achenes glabrous.

COLOMBIA: in dense forests of the Central Andes, Popayán, alt. 2800–3300 m., March, 1901, *F. C. Lehmann,* no. *B.T. 493* (Kew Hb., TYPE, N. Y. Bot. Gard. Hb., photograph of type in Mo. Bot. Gard. Hb.).

Senecio Sepium Schz. Bip. in Bull. Soc. Bot. Fr. **12**: 80. 1865, name only; Linnaea **34**: 531. 1866, name only; Rusby in Bull. N. Y. Bot. Gard. **4**: 394. 1907, in part, as to *Mandon,* no. *133,* not as to plant of *Bang.*

Heads heterogamous, 8–10 mm. high, radiate; involucre campanulate, calyculate, glabrous; bracts of the involucre about 13, glabrous and, as well as the bracteoles, purplish or black towards the apex; ray-flowers usually 8, tube slender, rays narrowly oblong, 5–6 mm. long; disk-flowers about 35; mature achenes 2 mm. long, hirtellous.

BOLIVIA: vicinity of Sorata, alt. 2650–3700 m., 8 June, 1859, *Mandon,* no. *133* (N. Y. Bot. Gard. Hb. and Mus. Nat. Hist. Hb., Vienna).

The Bang plant to which Dr. Rusby referred, following the original description of the species, although a rather imperfect specimen, is unquestionably an *Erechtites.*

Senecio sinuatilobus DC. Prodr. **6**: 417. 1837.

CHILE: Valparaiso, coll. of 1856–1857, *Germain, s.n.* (Mus. Nat. Hist. Hb., Vienna); Fray Jorge, Dep't. of Ovalle, Prov. of Coquimbo, alt. 500 m., Nov., 1925, *Werdermann,* no. *926* (Field Mus. Hb. and Mo. Bot. Gard. Hb.); San Antonio, Dep't. of San Antonio, Prov. of Santiago, 16 Oct., 1927, *Montero,* no. *211* (Mo. Bot. Gard. Hb.).

Senecio sotarensis Hieron. in Engl. Bot. Jahrb. **21**: 360. 1895.

COLOMBIA: Volcan Sotará, Feb., 1869, *A. Stübel,* no. *3392* (Berlin Hb., fragment and photograph in Mo. Bot. Gard. Hb.).

Ecuador: in ravines near Quito, *Jameson,* no. *856* (Kew Hb); in Valley Lloa, near Quito, Sept., 1918, *Luis Mille,* no. *733* (N. Y. Bot. Gard. Hb.).

Senecio stigophlebius Baker in Mart. Fl. Bras. **6**^{3}: 321. 1884.

Brazil: without definite locality, *Sello* [*Sellow*], no. *2187* (Gray Hb., *co-type);* vicinity of Itatiaya, 26–30 July, 1915, *Rose & Russell,* nos. *20504* and *20549* (U. S. Nat. Hb. and Mo. Bot. Gard. Hb.).

Senecio subcandidus Gray in Proc. Am. Acad. **5**: 141. 1861.

Peru: Obrajillo, *U. S. Expl. Exp. under command of Capt. Wilkes, s.n.* (U. S. Nat. Hb.), type; Guamautanga, June, 1838, *Barclay,* no. *2288* (British Mus. Hb.); Mutucana, alt. about 8000 ft., 12 April–3 May, 1922, *Macbride & Featherstone,* nos. *156, 160, 177,* and *414* (Field Mus. Hb.); open rocky slope, Canta, Dep't. of Lima, alt. 2700–3200 m., *Pennell,* no. *14337* (Field Mus. Hb.).

Senecio suglomerosus Greenm. in Ann. Mo. Bot. Gard. **10**: 93. 1923.

Peru (?): "western South America, woods about Sta. Cruz, alt. 6–8000 ft.," July, 1865, *Richard Pearce, s.n.* (British Mus. Hb. and Kew Hb.).

Senecio tephrosioides Turcz. in Bull. Soc. Nat. Mosc. **24**^{2}: 92. 1851.

Senecio subdecurrens Schz. Bip. ex Wedd. Chlor. And. **1**: 109. 1855; Schz. Bip. in Bonplandia **4**: 55. 1856; Greenm. in Ann. Mo. Bot. Gard. **10**: 93. 1923.

Ecuador: Sangai(?), *Karsten* (Mus. Nat. Hist. Hb., Vienna); "Andium Quitensium," alt. 13000 ft., *W. Jameson,* no. *556* (Mus. Nat. Hist. Hb., Vienna).

From the characters recorded in the original descriptions and from the material at hand, I am unable to distinguish the above as distinct species. Therefore, I have taken the earlier published name.

Senecio teretifolius (HBK.) DC. Prodr. **6**: 420. 1837.

Cacalia teretifolia HBK. Nov. Gen. & Sp. Pl. **4**: 159, *pl. 357.* 1820.

Ecuador: Quito, *Karsten, s.n.* (Mus. Nat. Hist. Hb., Vienna); Asuai, *Karsten, s.n.* (Mus. Nat. Hist. Hb., Vienna).

Chile: Cordil. de Santiago, coll. of 1856–1857, *Germain* (Mus. Nat. Hist. Hb., Vienna).

Senecio tolimensis Schz. Bip. ex Wedd. Chlor. And. **1**: 98–99. 1855.

Colombia: without definite locality, coll. of 1760–1808, *José Celestino Mutis,* no. *1787* (U. S. Nat. Hb.).

Senecio trichopus (Benth.) Greenm., n. comb.

Microchaete trichopus Benth. Pl. Hartw. p. 209. 1845.

Senecio pulchellus β. *trichopus* Wedd. Chlor. And. **1**: 100. 1855.

Colombia: Prov. of Popayán, *Hartweg,* no. *1163* (N. Y. Bot. Gard. Hb.), part of type collection; headwaters of Rio Lopez, Rio Palo Basin, Tierra Adentro, alt. 2500–3000 m., 24 Jan., 1906, *H. Pittier,* no. *1085* (U. S. Nat. Hb.).

Senecio tristis Phil. var. **Comberi** Greenm., n. var.

Plantae suffruticosae, ubique hirsuto-glandulosae; caulibus ascendentibus, usque ad 3 dm. altis; foliis crassulis, oblanceolatis vel oblongo-oblanceolatis, 1.5–3 cm. longis, 3–13 mm. latis, plerumque mucronatis, integris vel versus apicem pauci-dentatis; capitulis homogamis aut radiatis; involucris campanulatis, paulo calyculatis, 1.3–1.5 cm. altis; involucri squamis 21, lineari-lanceolatis, attenuatis, 10–12 mm. longis; floribus femineis (si adsint) ca. 13, ligulis anguste oblongis, flavis; floribus disci ca. 45; achaeniis glabris vel minute hirtellis.

Plant suffruticose, hirsute-glandular throughout; stems ascending, 1–3 dm. high; leaves fleshy, oblanceolate to oblong-oblanceolate, 1.5–3 cm. long, 3–13 mm. broad, usually mucronate, entire or few-toothed toward the apex; heads discoid or radiate; involucre campanulate, 1.3–1.5 cm. high, sparingly calyculate; bracts of the involucre about 21, linear, attenuate, 10–12 mm. long; ray-flowers, when present, about 13, rays narrowly oblong, yellow; disk-flowers about 45; achenes glabrous or minutely hirtellous.

Argentina: Andes Expedition, 38°–41° S., "Norquinco

P.," alt. 3700 ft., 12 Feb., 1926, *H. F. Comber*, no. *533* (Kew Hb., TYPE; photograph in Mo. Bot. Gard. Hb.).

CHILE: Aguas Calientes, Baños de Chillan, Prov. of Nuble, alt. about 2200 m., *E. Werdermann*, no. *1320* (Berlin Hb. and Mo. Bot. Gard. Hb.).

The present variety differs from the species, as it was described originally, in having longer stems, larger leaves, radiate instead of discoid heads, and in having 21 instead of 12 involucral bracts. The writer feels that the plant concerned represents only an extreme variation of the Philippi species.

Senecio Urbani Hieron. in Engl. Bot. Jahrb. **28**: 640. 1901.

COLOMBIA: Prov. of Popayán, *Triana*, no. *1489* (Berlin Hb., TYPE, fragment and photograph in Mo. Bot. Gard. Hb., Mus. Nat. Hist. Hb., Vienna); Las Cañas, 23 Nov., 1853, *I. F. Holton*, no. *386* (N. Y. Bot. Gard. Hb.); without specific locality, coll. of 1760–1808, *José Celestino Mutis*, no. *237* (U. S. Nat. Hb.); La Cumbre, Dep't. of El Valle, Cordillera Occidental, alt. 1500–1700 m., 11–16 July, 1922, *Hazen*, no. *11835* (U. S. Nat. Hb.); grassy slopes, west of Salento, Dep't. of Caldas, Cordillera Central, alt. 1600–1900 m., 25–31 July, 1922, *Killip & Hazen*, no. *8769* (U. S. Nat. Hb.); forest below Magana, Old Quindio Trail, Cordillera Central, Dep't. of Caldas, alt. 3000–3200 m., 1–2 Aug., 1922, *Killip & Hazen*, no. *9483* (U. S. Nat. Hb.); open trail, La Cumbre, Dep't. of El Valle, Cordillera Occidental, alt. 1600–1800 m., *Killip*, no. *11413* (U. S. Nat. Hb.).

Senecio vaccinioides (HBK.) Schz. Bip. ex Wedd. Chlor. And. **1**: 99. 1855.

COLOMBIA: without definite locality, coll. of 1842, *Linden*, no. *741* (Mus. Nat. Hist. Hb., Vienna).

Senecio vaccinioides (HBK.) Schz. Bip. var. **pruinosa** Wedd. Chlor. And. **1**: 99. 1855.

COLOMBIA: without definite locality, coll. of 1760–1808, *José Celestino Mutis*, no. *1817* (U. S. Nat. Hb.).

Senecio verticillatus Klatt in Abhl. Naturf. Ges. Halle **15**: 331. 1882.

Peru: Chachapoyas, coll. of 1836, *Mathews*, no. *105*. (Kew Hb.).

The specimen here cited agrees with the original description of this species; moreover, it comes from the type locality and in all probability is a part of the collection on which the species was founded. The leaf-bases are persistent and cause a roughness of the stem which, however, is otherwise glabrous as described by Dr. Klatt. That the species is a variable one is indicated by several specimens collected by Mr. Mathews at Chachapoyas and other stations. One variant with conspicuously hirsute-setose branches and branchlets seems worthy of varietal designation.

Senecio verticillatus Klatt var. **trichophorus** Greenm., n. var.

Frutex; ramis ramulisque juventate hirsuto-setosis denique plus minusve glabratis; ramis aliquanto secundis.

Peru: Chachapoyas, without date of collection, *Mathews, s.n.* (Kew Hb., type); Bajasan, coll. of 1835, *Mathews*, no. *1375* (Kew. Hb.); without definite locality, *Mathews, s.n.* (U. S. Nat. Hb., sheet no. *245952*).

Senecio Werdermannii Greenm., n. name.

Senecio modestus Philippi in Linnaea **28**: 745. 1856, not *S. modestus* Wedd. Chlor. And. **1**: 105, *pl. 18, fig. B*. 1855.

Chile: Cordilierès de Santiago, coll. of 1856–1857, *Germain, s.n.* (Mus. Nat. Hist. Hb., Vienna); Fierro Carrera, Cord. Rio San Francisco, Prov. of Santiago, alt. 3200 ft., *Werdermann*, no. *645* (Field Mus. Hb. and Mo. Bot. Gard. Hb.).

Senecio yurensis Rusby in Bull. N. Y. Bot. Gard. **8**: 133. 1912.

Peru: near Arequipa, 8 Aug., 1914, *Mr. & Mrs. J. N. Rose*, no. *18830* (U. S. Nat. Hb. and Mo. Bot. Gard. Hb.); Vincocaya, 21 Aug., 1914, *Mr. & Mrs. J. N. Rose*, no. *18947* (U. S. Nat. Hb. and Mo. Bot. Gard. Hb.).

CONTRIBUTIONS TOWARD A FLORA OF PANAMA[1]

II. Miscellaneous Collections during 1936–1938

ROBERT E. WOODSON, JR.
Assistant Curator of the Herbarium, Missouri Botanical Garden
Assistant Professor in the Henry Shaw School of Botany of Washington University

AND RUSSELL J. SEIBERT
Formerly Assistant in Botany, Henry Shaw School of Botany of Washington University

Among the most interesting botanical collections made in Panama during the year 1937 is a series of approximately seventy-five numbers sent the Missouri Botanical Garden by Gene and Peggy White. Although a part of these specimens is from the Canal Zone, the majority was secured from the neighborhood of the upper Río Chiriquí Viejo watershed in the Province of Chiriquí, a locality visited in the summer of 1935 by R. E. Woodson, Jr. and R. J. Seibert (cf. Ann. Missouri Bot. Gard. **24**: 175–210. 1937). A surprising proportion of this collection consists of novelties or additions to the known flora of Panama.

The present report also includes miscellaneous collections made in various localities in Panama by P. H. Allen, Manager of the Missouri Botanical Garden Tropical Station, Balboa, C. Z. Of these, perhaps greatest interest is attached to a representative series of plants collected in the valleys of Río Tuyra and Río Yape, in the Province of Darien. An interesting account of Allen's experiences during this trip is printed in Missouri Bot. Gard. Bull. **25**: 114–122. 1937. Unfortunately a portion of this collection, together with the great majority of a collection of some 1,200 numbers secured during the summer of 1937 by Woodson, Allen, and Seibert, was destroyed by a fire which badly damaged the administration building of the Tropical Station in Balboa the night of September 1, 1937.

[1] Issued November 28, 1938.

POLYPODIACEAE

(William R. Maxon, Washington, D. C.)

DRYOPTERIS HOSTMANNI (Kl.) Maxon & Morton. VERAGUAS: trail between Cañazas and the foot of the Cordillera Central, headwaters of Río Cañazas, alt. 300–600 m., Feb. 8, 1937, *(Allen 164)*. Previously known only from British and Dutch Guiana.

DRYOPTERIS LINDIGII C. Chr. VERAGUAS: trail between Cañazas and the foot of the Cordillera Central, headwaters of Río Cañazas, alt. 300–600 m., Feb. 8, 1937 *(Allen 171)*. Previously known from Costa Rica, Colombia, and Venezuela.

ELAPHOGLOSSUM SILIQUOIDES (Jenman) C. Chr. COCLÉ: vicinity of El Valle, alt. 700–1000 m., very cool, dark forest, Feb. 14, 1937 *(Allen 233)*. Previously known from Jamaica, Cuba, Hispaniola, Guatemala, and Costa Rica.

AMARYLLIDACEAE

CRINUM **darienensis** Woodson, spec. nov.; bulbis non bene evolutis ovato-oblongoideis 1.2–1.7 cm. diametro stoloniferis; foliis basi amplexicaulibus in vagina productis 20–32 cm. longis, lamina oblongo-elliptica apice abrupte subcaudato-acuminata plana delicate subsucculento-membranacea 3.5–5.5 cm. lata basi obtusa in petiolo 0.6–1.0 cm. lato producta, margine subcartilagine eroso-denticulato, vagina 3–5 cm. longa 0.8–1.5 cm. lata; pedunculis 9–14 cm. longis 2–4-floris, spatha sub anthesi usque basin 2-partita parte utraque ensiformi ad 7 cm. longa; floribus sessilibus; perianthi tubo gracillimo 21–25 cm. longo basi ca. 0.15 cm. diametro prope fauces paullo dilatato ut videtur albido, lobis oblongo-ellipticis apice acuminatis albis 7.5–8.0 cm. longis 1.2–1.5 cm. latis; staminis filamenta subulata rubra ca. 4 cm. longa, anthera oblonga arcuata 1.2 cm. longa; ovario ellipsoideo 1.2–1.5 cm. longo ca. 0.4 cm. diametro, stylo rubro 4.5 cm. longo, stigmate punctiforme.—DARIEN: trail between Pinogana and Yavisa, alt. ca. 15 m., March 17, 1937, *P. H. Allen 264* (Herb. Missouri Bot. Garden, TYPE).

This plant is scarcely to be confused with the neighboring

C. erubescens, or with any other species known to me, because of the small leaves of unusual shape for the genus, and the small, poorly developed bulbs which consist scarcely of more than the sheathing leaf bases. Several plants of this species were collected by Mr. Allen, all agreeing with the general description. The flowers are said to be delicately fragrant. A peculiar tendency for the sap of cut bulbs to oxidize to a dull red has been noticed upon all of the specimens.

BURMANNIACEAE

(F. P. Jonker, Utrecht)

GYMNOSIPHON SUAVEOLENS (Karst.) Urb. CHIRIQUÍ: valley of the upper Río Chiriquí Viejo, alt. 1300–1900 m., July–Aug., 1937 *(Gene & Peggy White 15, 24).* Previously known from Mexico, Guatemala, Costa Rica, Colombia, Venezuela, and Brazil.

ORCHIDACEAE

(Charles Schweinfurth, Cambridge, Mass.)

CYCNOCHES CHLOROCHILON Kl. PANAMÁ: Río La Maestra, alt. 0–25 m., Dec. 4, 1936 *(Allen 65).* Previously known from British Honduras, Venezuela, Colombia, and British Guiana.

CRANICHIS MUSCOSA Sw. COCLÉ: vicinity of El Valle, alt. 800–1000 m., terrestrial, among rocks along stream, Dec. 22, 1936 *(Allen 74).* Previously known from Florida, Costa Rica, the West Indies, and Venezuela.

PIPERACEAE

(William Trelease, Urbana, Ill.)

PEPEROMIA **Alleni** Trelease, spec. nov. Herba epiphytica repens omnino glabra parva sed comparate megaphylla; caule graciliusculo; foliis oppositis orbicularibus vel subovato-ellipticis apice basique acutis subacutisve, ca. 1.5 × 2.0 cm., 3-nervatis post exsiccationem coriaceis, petiolo 0.5 cm. longo; spicibus terminalibus etiam 0.1 × 3.0 cm., pedunculo 1.5 cm. longo.—DARIEN: Pinogana-Yavisa trail, alt. 15 m., March 17, 1937, *P. H. Allen 262* (Herb. Missouri Bot. Garden, TYPE).

Peperomia **cocleana** Trelease, spec. nov. Herba repens parva foliis exceptis omnino glabra; caule filiforme, internodiis brevibus; foliis alternatis orbicularibus obtusis vel subtruncatis basi acutis vix 0.5 cm. diametro metientibus, ciliatis; petiolo filiforme 0.2 cm. longo; spicibus axillaribus vix 0.2 × 0.4 cm., pedunculo vix 0.5 cm. longo.—coclé: on boulders, upper Río Mata Ahogado valley, alt. 350 m., Dec. 31, 1936, *P. H. Allen 133* (Herb. University of Illinois, type, Herb. Missouri Bot. Garden, isotype).

Piper **Alleni** Trelease, spec. nov. Arbor ca. 7 m. alta; internodiis gracilibus sat brevibus sparse subvelutinis; foliis lanceolatis apice anguste acuminatis basi oblique subacutis 6.0–6.5 cm. latis 17–18 cm. longis inferne pinnate nervatis, nervis ca. 5 + 2, supra lepidoto-scabridulis subtus subvelutinis; spicibus rectibus 0.2 × 5.0 cm., pedunculo 0.5–1.0 cm. longo.—darien: Pinogana-Yavisa trail, alt. 15 m., March 17, 1937, *P. H. Allen 270* (Herb. University of Illinois, type, Herb. Missouri Bot. Garden, isotype).

Mr. Allen reports that the roots are said to be used to deaden pain, and the leaves as an antidote for snake venom.

Piper **canyazasense** Trelease, spec. nov. Arborescens ca. 2 m. alta; internodiis superis gracilibus brevibusque puberulis; foliis elliptico-lanceolatis apice falcate angusteque acuminatis basi inaequilateraliter rotundatis 11–15 cm. longis 4.5–5.0 cm. latis inferne pinnate nervatis, nervis ca. 6 + 5, leviter rugosis ciliatis supra minute scabro-pubescentibus subtus puberulis, petiolo ca. 0.5 cm. longo velutino; spicibus vix 0.2 × 1.5 cm., brevi-pedunculatis.—veraguas: Cañazas trail to the central cordillera, alt. 300–600 m., Feb. 8, 1937, *P. H. Allen 185* (Herb. University of Illinois, type, Herb. Missouri Bot. Garden, isotype).

Piper san-joseanum C.DC. var. **chiriquinum** Trelease, var. nov. Frutex ca. 2 m. altus; foliis ovatis acuminatis basi retuse subtruncatis 10–13 cm. longis 8–10 cm. latis, petiolo 4 cm. longo; spicibus rectibus vel reflexis 0.3 × 12.5 cm., pedunculo 0.5 cm. longo.—chiriquí: between Río Tabasará and Río Tinta, Aug. 11, 1937, *Woodson, Allen & Seibert 416* (Herb. Missouri Bot. Garden, type).

PIPER **tabasaranum** Trelease, spec. nov. Arbor parva ca. 4–5 m. alta omnino glabra; internodiis graciliusculis brevibus; foliis ellipticis breve-caudatis basi acutis 4.0–5.5 cm. latis 9–10 cm. longis 5-jugis, nervis utrinque prominentibus, petiolo vix 0.5 cm. longo; spicibus ca. 0.3 × 5.0 cm., floribus congestis, pedunculo 1 cm. longo, bracteis subcucullatis; baccis ovoideis; stigmatibus 3 sessilibus.—CHIRIQUÍ: banks of lower Río Tabasará, Aug. 12, 1937, *Woodson, Allen & Seibert 440* (Herb. Missouri Bot. Garden, TYPE).

PIPER **yapeanum** Trelease, spec. nov. Arbor ca. 15 m. alta; internodiis florigeris sat gracilibus brevibusque sparsiuscule subvillosis; foliis late lanceolatis gradatim anguste acuminatis basi inaequilateraliter rotundatis vel subcordatis 15–17 cm. longis 6–7 cm. latis inferne pinnate nervatis, nervis ca. 6 + 5 supra minute scabridis subtus sparse subvillosis, petiolo ca. 1 cm. longo sparse villoso; spicibus paene rectis 0.3 × 4.0 cm., pedunculo 0.5 cm. longo glabrato.—DARIEN: near the mouth of Río Yape, alt. 20 m., July 12–14, 1937, *P. H. Allen 351* (Herb. University of Illinois, TYPE, Herb. Missouri Bot. Garden, ISOTYPE).

PODOSTEMONACEAE

MARATHRUM **Allenii** Woodson, spec. nov., rhizomate repente sat tenue frondoso; foliorum petiolo 1.0–1.5 cm. longo inferne basi saepius late vaginato, lamina late ovata vel oblongo-elliptica 2–13 cm. longa 1.5–4.0 cm. lata 5-pinnatifida, laciniis ultimis acutis vel obtusiusculis subdichotomis ca. 0.1 cm. longis linearibus; floribus solitariis rariusve subfasciculatis, spathellis 0.9–1.5 cm. longis cylindrico-obconicis margine profunde laciniatis, pedicellis usque 5 cm. longis apice in poculo calyciforme ca. 0.15 cm. diam. dilatatis, tepalis 6 minute triangularibus ca. 0.2 mm. longis; staminis 6 filamenta 0.15 cm. longa inferne planiuscula superne filiforme, anthera anguste sagittata 0.25 cm. longa; ovario ovoideo ca. 0.3 cm. longo 0.1 cm. crasso distincte 6-nervato basi attenuato, stigmate basi connato 0.1 cm. longo; capsulis oblongo-ovoideis ca. 0.4 cm. longis 0.2 cm. crassis.—COCLÉ: vicinity of El Valle, alt. 800–1000 m., on rocks in fast water, Dec. 22, 1936, *P. H. Allen 82* (Herb. Missouri Bot. Garden, TYPE).

This specimen keys to the neighborhood of *M. Schiedeanum* Cham. in Standley's 'Flora of the Panama Canal Zone.' However, a comparison of *Allen 82* with *Schiede & Deppe 965* (in Herb. Missouri Bot. Garden), the type collection of *M. Schiedeanum,* demonstrates that not only is the rhizome of *M. Allenii* very much more frondose, the enlarged bases of the leaf petioles almost stipular, but the spathellae are also distinct, those of *M. Allenii* being deeply and irregularly lacerate and those of *M. Schiedeanum* rather regularly and bluntly 2-lobed. The laceration of the spathella also serves to separate *M. Allenii* from *M. foeniculaceum* H. & B.

NYCTAGINACEAE

(P. C. Standley, Chicago)

NEEA ACUMINATISSIMA Standl. DARIEN: trail between Yavisa and Pinogana, March 17, 1937 *(Allen 268).* Previously known from Honduras and British Honduras.

MAGNOLIACEAE

MAGNOLIA **sororum** Seibert, spec. nov. Arbor 22 m.; ramuli juniores dense fulvo-pubescentes; folia petiolata persistentia; lamina elliptico-ovata vel obovata vel oblonga, basi obtusa vel rotunda, apice obtusa vel subacuta vel subacutata, 6–15 cm. longa, 3–9.5 cm. lata, coriacea, supra glabrescens, primo costae basim versus fulvo-pubescens, subtus dense fulvo-pubescens, leviter revoluta; petioli 1–3 cm. longi, apice canaliculati ceterum teretes dense fulvo-pubescentes; stipulae a petiolo liberae, extus dense fulvo-pubescentes; flores albi fragrantes; alabastrum initio bracteis spathoideis 2 deciduis inclusum; bracteae extus dense fulvo-pubescentes; pedunculus 1.5–2.5 cm. longus, dense fulvo-pubescens; tepala 9, 3 exteriora obovato-oblonga, 5.5–6 cm. longa 2.5–3 cm. lata, extus basi sparse fulvo-pubescentia, 6 interiora obovata basi angustiora, 5.5–7 cm. longa, 2–4.5 cm. lata, glabra; stamina numerosissima, 1.3–1.5 cm. longa, antheris sessilibus linearibus introrse dehiscentibus. Fructus 4.5–6 cm. longus; carpella 32–45, dense fulvo-pubescentia.—CHIRIQUÍ: valley of the upper Río Chiri-

quí Viejo, alt. 1800 m., July, 1937, *Gene & Peggy White 21* (Herb. Missouri Bot. Garden, TYPE).

This is apparently the first representative of the genus *Magnolia* to be reported south of Costa Rica. *M. sororum* differs from the other Central American species by being densely and generally fulvo-pubescent. It is immediately distinguishable from *M. poasana* (Pittier) Dandy, by its pubescence, broader and longer inner perianth segments, and greater number of carpels, and from *M. guatemalensis* Donn. Sm., which is a nearly glabrous tree with cuspidate leaves and fewer carpels. Its closest congener seems to be *M. Yoroconte* Dandy, on the basis of carpel numbers and the two spathaceous bracts which enclose the flower bud, but may be easily distinguished by its dense pubescence, larger leaves, and larger flowers. This species is quite abundant in a limited zone between 1650 and 2120 m., occurring both on the east and northwest side of the Volcán de Chiriquí. Named in honor of the two sisters, Gene and Peggy White, who made a special effort to recollect the plant after the writer's original specimens were lost by fire.

THEACEAE

(P. C. Standley, Chicago)

EURYA **panamensis** Standl., spec. nov. Arbor 10–12-metralis ut videtur dense ramosa, ramulis teretibus cinnamomeis, novellis sparse pilis brevibus adpresso-pilosis vel fere glabris, internodiis brevibus; folia parva breviter petiolata coriacea, petiolo crasso 3–4 mm. longo sparse breviter sericeo vel glabrato; lamina cuneato-obovata vel oblongo-obovata 2.5–5.5 cm. longa 1–2.5 cm. lata, apice rotundata vel obtusa, basin versus sensim cuneato-angustata, basi ipsa acuminata, margine basin versus integro vel subintegro, superne arcte crenato-serrato, crenaturis obtusis adpresso-incurvis, supra glabra, in sicco cinerascens sublucida, costa subimpressa, nervis vix prominulis, subtus pallidior, primo sat dense sericea sed cito glabrata, costa prominente crassiuscula, nervis lateralibus utroque latere ca. 12 tenerrimis prominulis angulo semirecto adscendentibus in marginem desinentibus, venis paucis re-

motis prominulis laxe reticulatis; flores solitarii vel geminati, pedicellis 9–12 mm. longis glabris plerumque recurvis; sepala adpressa paullo inaequalia, exteriora breviora, interiora 4 mm. longa suborbicularia, apice late rotundata et minute apiculata, glabra, minute ciliolata; petala alba glabra obovato-spathulata emarginata 5–6 mm. longa; stamina ca. 25, filamentis elongatis filiformibus antheris triplo longioribus, antheris brevibus apice sparse breviter pilosis; ovarium glabrum.—CHIRIQUÍ: valley of upper Río Chiriquí Viejo, alt. 1,300–1,900 m., July 16, 1937, *Gene & Peggy White 16* (Herb. Field Museum, TYPE; Herb. Missouri Bot. Garden, ISOTYPE).

The flowers are described as very fragrant. From all other Central American species of the genus the tree of Chiriquí is distinguished by the small, obovate leaves with very obtuse or rounded apex.

PASSIFLORACEAE

(Ellsworth P. Killip, Washington)

PASSIFLORA SALVADORENSIS Donn. Sm. CHIRIQUÍ: valley of the upper Río Chiriquí Viejo, near Monte Lirio, alt. 1300–1900 m., March 20, 1938 *(Gene White 25)*. Previously known only from Salvador.

BEGONIACEAE

(P. C. Standley, Chicago)

BEGONIA **Allenii** Standl., spec. nov. Terrestris ca. 40 cm. alta, ut videtur erecta, caulibus sat gracilibus multifoliatis pilis laxis patentibus villosis vel glabratis, internodiis brevibus; stipulae deciduae tenues glabrae integrae late ovali-oblongae acutiusculae, apiculatae vel breviter mucronatae, 1 cm. longae; folia mediocria brevissime petiolata in sicco tenuia, petiolo gracili 5–9 mm. longo sparse villoso vel glabrato; lamina oblique cuneato-oblanceolata 7–11.5 cm. longa 2–3.5 cm. lata, apicem versus latissima, longe anguste attenuato-acuminata, basin versus longe sensim attenuata, basi paullo obliqua utroque latere acutissima, supra glabra viridis, subtus pallida, ubique

densissime cystosphaeriis pallidis obsita, glabra vel tantum ad costam praesertim basin versus sparse villosa, margine superne breviter sinuato-lobato atque remote serrulato, basin versus integro; cymae plerumque axillares laxe pauciflorae 2–5 cm. longae 2.5–8.5 cm. latae, basi bifidae, graciliter 3–7 cm. longe pedunculatae, pedicellis gracillimis viscido-villosulis 3–4 mm. longis, fructiferis usque 10 mm. longis; sepala exteriora floris masculi roseo-rubra glabra ovato-rotundata ca. 4 mm. longa atque aequilata, apice rotundata, basi subtruncata; capsula ambitu suborbicularis 8 mm. longa 10 mm. lata, glabra, basi et apice late rotundata vel subtruncata, trialata, alis subaequalibus tenuibus reticulato-venosis ca. 3 mm. latis. —COCLÉ: vicinity of El Valle, north rim, 800–1,000 m., Feb. 14, 1937, *P. H. Allen 234* (Herb. Field Museum, TYPE; Herb. Missouri Bot. Garden, ISOTYPE).

Practically all the known Begonias of Panama were described by Casimir De Candolle, and their total number is not large as compared with those of Costa Rica. While I am uncertain as to the nearest affinities of the present plant, careful search of the literature shows that it is not closely related to any species known from Panama or Costa Rica. The penninerved leaves are distinctive, being very asymmetric, with a long, narrow acumination and a very long, narrow, tapering base.

This *Begonia* is only one of a considerable number of interesting additions made to the known flora of Panama by Mr. Allen, whose well-prepared specimens show a keen sense of discrimination in their selection.

COMBRETACEAE

(P. C. Standley, Chicago)

BUCHENAVIA CAPITATA (Vahl) Eichl. PANAMÁ: Río La Maestra, Dec. 4, 1936 *(Allen 35)*. Genus new for Central America. It is rather probable that this represents a distinct new species, but the material (fruiting) is scant, and the observable differences are principally in the leaves. *B. capitata* has a rather wide range, from the West Indies to the Guianas and Brazil.

MYRSINACEAE

(P. C. Standley, Chicago)

ARDISIA **furfuracella** Standl., spec. nov. Arbor 6-metralis, ramis teretibus ferrugineis, novellis crassiusculis minutissime adpresse ferrugineo-furfuraceis, internodiis brevibus; folia inter minora breviter petiolata tenuiter coriacea, petiolo crassiusculo 5–8 mm. longo minute furfuraceo; lamina anguste lanceolato-oblonga 8–11 cm. longa 2.5–3.2 cm. lata subabrupte acuminata, acumine ipso obtuso, basi acuta, integerrima, supra in sicco olivaceo-viridis glaberrima sublucida vel opaca, costa gracili prominente, nervis obscuris non elevatis, subtus multo pallidior, ubique sat dense sed minutissime furfuraceo-lepidota, costa gracili prominente, nervis lateralibus utroque latere ca. 12 tenerrimis prominulis arcuatis angulo lato abeuntibus, venulis laxe reticulatis; inflorescentia terminalis bipinnatim paniculata foliis duplo brevior, dense multiflora, ramis crassiusculis dense minute furfuraceo-lepidotis, floribus umbellato-corymbosis, bracteis oblongis usque 6 mm. longis ut videtur deciduis pallidis sat dense punctatis, pedicellis brevibus; sepala ante anthesin vix ultra 1 mm. longa ovalia pallida dense punctata; cetera ignota.—CHIRIQUÍ: valley of upper Río Chiriquí Viejo, alt. 1,300–1,900 m., July 13, 1937, *Gēne & Peggy White 8* (Herb. Field Museum, TYPE; Herb. Missouri Bot. Garden, ISOTYPE).

"A tree of 6 meters, with very hard wood; buds orange-yellow. Growing in open sunlight." The material, unfortunately, is in very young bud, and it is impossible to describe the details of the flowers. The curious indument of the lower leaf surface, consisting of minute, dense, yellowish or brownish, peltate scales is not matched in any other Central American species known to me.

APOCYNACEAE

PLUMERIA INODORA Jacq. PANAMÁ: Bella Vista, Panama City, Feb. 20, 1938 *(Allen s.n.)*. *P. inodora* has been recorded previously only from Colombia and British Guiana, apparently never in the cultivated state (cf. Woodson, Ann. Missouri Bot. Gard. **25**: 206. 1938). In Panama it is known only from Bella

Vista, a rather newly developed "subdivision" of Panama City, where trees of considerable size are found occasionally in vacant lots as well as in the gardens of the pretentious residences of the community. Upon inquiry the owners of the trees invariably confessed complete ignorance concerning their origin. Hence, whether the species is indigenous or introduced cannot be ascertained at present.

STEMMADENIA DONNELL-SMITHII (Rose) Woodson. CHIRIQUÍ: vicinity of Río Tabasará, along highway, Aug. 11, 1937 *(Woodson, Allen & Seibert 411)*. This tree has previously been known virtually throughout Central America from southern Mexico (Guerrero) to Costa Rica. As this station is only across the river from the province of Veraguas, the known distribution of the genus is thus extended considerably south of the Costa Rican border.

ECHITES TURBINATA Woodson. CHIRIQUÍ: valley of upper Río Chiriquí Viejo, between El Volcán and Cerro Punta, March 15, 1938 *(Gene White 6)*. Previously known only from the type locality, near Rancho Flores, Costa Rica. Although almost unquestionably this species, Miss White's specimens show a much more luxuriant liana than the type specimen, the inflorescences averaging over 40 flowers, the corolla lobes of which attain 2.5 cm. in length.

ASCLEPIADACEAE

VINCETOXICUM **discolor** Woodson, spec. nov., fruticosa volubilis; foliis oppositis longiuscule petiolatis ovatis apice breviter subcaudato-acuminatis basi latiuscule cordatis 7.5–12.0 cm. longis 4.5–7.5 cm. latis membranaceis, nervo medio venisque supra subtusque minute ferrugineo puberulis nervo medio basi supra conspicue glanduligero, caeterumque glabris post exsiccationem saturate atropurpureo-discoloratis, petiolis 2.5–3.0 cm. longis basi fossulatis; inflorescentiis alternolateralibus subumbellatis longiuscule pedunculatis paucifloris, pedunculis 5–7 cm. longis ut in ramulis ut videtur semper glabris, pedicellis 1.5–2.5 cm. longis minute ferrugineo-puberulis, bracteis minutis; calycis laciniis ovatis late acutis obtusisve ca. 0.4 cm. longis extus dense minuteque ferrugineo-puberulis

intus glabris glandulas minutas 5 extra-axillares munitis; corolla rotata ca. 3 cm. diametro post exsiccationem saturate livida in vivo ut dicitur fulvida venis multis viridibus, extus minutissime ferrugineo-papillata intus sparse pilosa, lobis late ovatis rotundatis ca. 0.9 cm. longis 0.8 cm. latis patulis, corona 5-gona lobis complicate 3-partitis (vide fig. 1); gynostegio sessile ca. 0.35 cm. diametro antherarum apicibus super stigmatem inflexis post exsiccationem albo-caeruleis con-

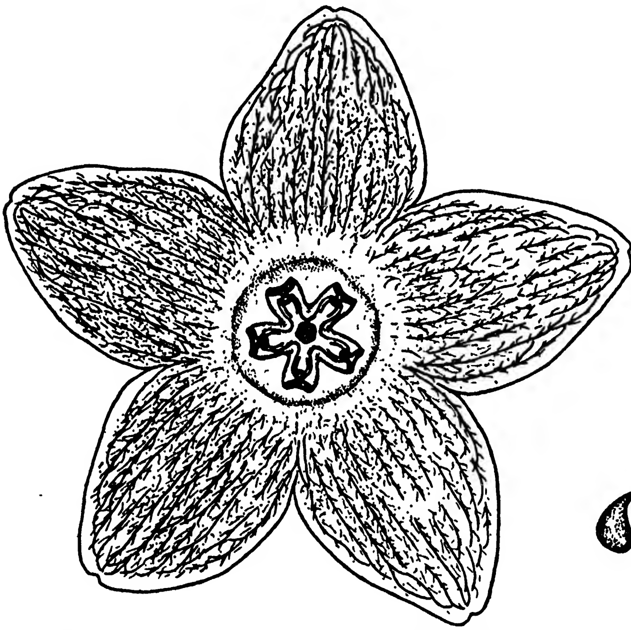


Fig. 1. *Vincetoxicum discolor* Woodson. Corolla (gynostegium removed to show corona) × 3, and pollinia, × 10.

spicuissimis, polliniis late obpyriformibus subhorizontalibus cum caudiculo ca. 0.075 cm. longo, retinaculo sagittato ca. 0.025 cm. longo; ovariis ovoideis minutissime papillatis ca. 0.2 cm. longis; folliculis ignotis.—CHIRIQUÍ: trail from Bambito to Cerro Punta, alt. 1400–2300 m., April 6, 1937, *P. H. Allen 322* (Herb. Missouri Bot. Garden, TYPE).

The literature concerning *Vincetoxicum* and its most closely related allies is so confusing that considerable temerity is nec-

essary for the publication of novelties without an exhaustive revision of the entire complex. Nevertheless it appears to me that *V. discolor* is quite outstanding amongst its congeners as I am acquainted with them. The marked and uniform discoloration of the dried foliage and flowers and the internally pilose corolla are rarities in the genus. One of the most striking features is the waxy pallor of the connivent anther-tips in the center of the darkly discolored, rotate corolla. Corona characters are so difficult to describe in this family that I have resolved, although rather belatedly, in the future always to accompany them with figures.

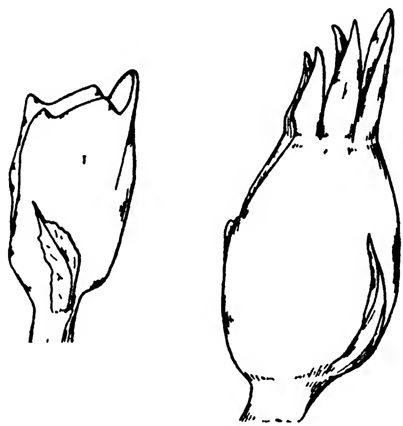


Fig. 2. Calyces of *Conopholis panamensis* Woodson (left) and *C. mexicana* Gray (right). Both figures × 6.

OROBANCHACEAE

CONOPHOLIS **panamensis** Woodson, spec. nov.; caulibus simplicibus strobiliformibus dense minuteque papillatis 5–20 cm. altis super radices quercorum parasitis; foliis scariaceis ovatis vel ovato-oblongis acuminatis 1.0–1.7 cm. longis, margine plerumque minute irregulariterque eroso-denticulata; inflorescentiis multifloris subspiciformibus omnino dense minuteque papillatis, bracteis ovatis vel ovato-oblongis acuminatis 0.7–1.0 cm. longis, pedicellis 0.3–0.5 cm. longis, bracteolis 2 oblongo-obovatis obtusis vel apice abrupte mucronato-acuminatis 0.2–0.4 cm. longis; calyce exigue 2-labiato 0.4–0.7 cm.

longo, lobis obtusis plerumque integris sat validis; corolla 1.2–1.6 cm. longa valde 2-labiata; staminis filamenta 1.0–1.5 cm. longa, anthera 0.2 mm. longa basi breviter appendiculata; ovario ovoideo ca. 0.4 mm. longo, stylo haud crasso 1.0–1.4 cm. longo, stigmate capitato; fructibus ovoideis 0.7–1.6 cm. longis, stylo caduco, seminibus fulvis ca. 0.15 cm. longis.—CHIRIQUÍ: trail from Bambito to Cerro Punta, alt. 1400–2300 m., April 6, 1937, *P. H. Allen 305* (Herb. Missouri Bot. Garden, TYPE); on hillside, valley of the upper Río Chiriquí Viejo, vicinity of Monte Lirio, alt. 1300–1900 m., June 27–July 13, 1935, *R. J. Seibert 298* (Herb. Missouri Bot. Garden, CO-TYPE).

Seibert 298 has previously been determined and cited in this series of contributions (Ann. Missouri Bot. Garden **24**: 202. 1937) as *C. americana* Wallr. From both the latter species and from *C. mexicana* Gray, however, *C. panamensis* may be distinguished by its calyx with rather shallow, broadly obtuse lobes and barely bilabiate structure. The calyx of the two former species is very strongly bilabiate in all material that I have seen, and the lobes acute to acuminate and much more deeply cleft. The broad bracts of *C. panamensis* recall those of *C. americana,* but the loss of the style in fruit resembles the similar condition of *C. mexicana.* In all material of the two previously described species that I have seen, the fruit disperses the seed by rupturing very irregularly. In the 38 specimens of *C. panamensis* that I have examined, however, slight pressure causes the fruit to break very regularly into two equal valves. The seeds of *C. panamensis* are about half again as large as those of *C. mexicana* and *C. americana,* and are distinguished also by their dark brown color. *C. panamensis* is common in the vicinity of the Volcán de Chiriquí, and has also been seen by me above Boquete.

RUBIACEAE

(P. C. Standley, Chicago)

GONZALAGUNIA **rosea** Standl., spec. nov. Frutex vel arbuscula 1–4.5 m. alta, ramis gracilibus teretibus brunneis, novellis dense pilis fulvidis vel sordidis subpatentibus vel adpressis

molliter pilosis, internodiis elongatis; stipulae 6–7 mm. longae e basi triangulari longe anguste attenuatae extus dense breviter hispidulae; folia mediocria breviter petiolata membranacea, petiolo ca. 1 cm. longo vel paullo ultra dense hispidulo; lamina lanceolato-oblonga 9–14 cm. longa, 2.5–5 cm. lata longe anguste attenuato-acuminata, basi acuta vel subobtusa, supra sat dense pilis brevibus plerumque patentibus pilosa, subtus fere concolor, molliter patenti-pilosa, costa gracili prominente, nervis lateralibus utroque latere ca. 13 valde obliquis angulo semirecto adscendentibus; inflorescentia anguste thyrsiformi-paniculata spiciformis solemniter elongata, sessilis vel pedunculata, usque 30 cm. longa atque 2.5 cm. lata, laxe multiflora, rhachi dense molliter pilosa, floribus in cymulas plerumque trifloras laxas breviter (vulgo 2–3 mm. longe) pedunculatas dispositis, pedicellis 1–3 mm. longis strigosis, bracteis minutis inconspicuis; hypanthium obovoideum 1 mm. longum strigosum, calyce 1.5–1.8 mm. longo campanulato extus sparse strigoso ad medium 4-lobulato, lobulis late ovatis acutis vel subobtusis suberectis; corolla rosea extus sparse vel dense albo-strigosa, tubo 6–8 mm. longo gracili tereti, lobis vix 2 mm. longis obtusis intus basin versus albo-pilosis; fructus depresso-globosus glabratus 4-coccus 2.5–3 mm. diam.—PANAMÁ: on damp, shaded stream bank, valley of the upper Río Chiriquí Viejo, Provincia de Chiriquí, alt. 1,300–1,900 m., July–Aug., 1937, *Gene & Peggy White 7* (Herb. Field Museum, TYPE; Herb. Missouri Bot. Garden, ISOTYPE).—COSTA RICA: without locality, *C. Hoffmann 534;* forests along Río La Paz de San Ramón, 1,000–1,025 m., *Brenes 4257;* Palmira, 2,100 m., in cloud forest, *Austin Smith 4217;* San Pedro Coronado, 1,400 m., *Manuel Valerio 1644* (all Costa Rican collections in Herb. Field Museum).

Probably a considerable number of Costa Rican specimens in other herbaria are referable to this species, which heretofore has been confused with *G. panamensis* (Cav.) Schum., a common plant in many parts of Central America. The two species are closely related, but *G. panamensis* seems to be constantly separable in the form of the inflorescence, consisting of sessile

cymules in which the flowers are sessile or very shortly pedicellate.

IXORA FLORIBUNDA (Rich.) Griseb. DARIEN: trail between Yavisa and Pinogana, March 17, 1937 *(Allen 298)*. Previously known from Cuba, El Salvador, Nicaragua, Costa Rica, and the north coast of Colombia. Collected very recently also in Honduras.

CHIOCOCCA PHAENOSTEMON Schlecht. CHIRIQUÍ: valley of the upper Río Chiriquí Viejo, alt. 1300–1900 m., July–Aug., 1937 *(Gene & Peggy White 38)*. Common in the mountains of Costa Rica, but previously unrecorded for Panama.

RAVNIA TRIFLORA Oerst. CHIRIQUÍ: valley of the upper Río Chiriquí Viejo, alt. 1300–1900 m., July–Aug., 1937 *(Gene & Peggy White 39)*. A handsome epiphyte, quite unlike most Rubiaceae in appearance, more suggestive, in fact, of Gesneriaceae. The genus has previously been known only in Costa Rica.

GUETTARDA **chiriquensis** Standl., spec. nov. Arbor 8–9-metralis, ramis vetustioribus cinereis subdense lenticellatis obtuse tetragonis crassis, novellis densissime pilis brevibus patentibus fulvis hirtellis, internodiis brevibus; stipulae deciduae ovato-triangulares 12–13 mm. longae, attenuato-acuminatae extus dense fulvo-strigosae; folia mediocria longipetiolata herbacea, petiolo crassiusculo 1.3–4 cm. longo dense pilis patentibus fulvo-piloso; lamina suborbicularis usque late ovalis vel late ovato-ovalis 5.5–12.5 cm. longa 4–9 cm. lata, apice subacuta usque subrotundata et saepe abrupte breviter cuspidato-acuminata, acumine angusto acuminato, basi late rotundata vel subtruncata, supra in sicco viridis sparse breviter hirtella vel glabrata, costa nervisque vix elevatis, subtus paullo pallidior dense pilis brevibus patentibus mollibus fulvidis pilosa, ad costam dense longipilosa, costa crassiuscula elevata, nervis lateralibus utroque latere ca. 11 prominentibus gracilibus valde arcuatis angulo lato, interdum fere recto, divergentibus, venulis arcte parallelis transversis vix prominulis; pedunculi bifurcati, pedunculo crasso 4–15 mm. longo, ramis 1–2.5 cm. longis dense 4–9-floris, floribus arcte sessilibus,

bracteis minutis; hypanthium 2–2.5 mm. longum densissime fulvo-tomentulosum; calyx 1 mm. longus brevissime remote 5-dentatus; corollae tubus 18 mm. longus crassiusculus densissime pilis retrorsis fulvis sericeus, lobis 5 ca. 4 mm. longis, intus glabris profunde lacerato-lobatis atque crispatis; fructus 4-locularis, acute 4-angulatus atque 4-sulcatus 7 mm. longus 5 mm. latus, puberulus.—CHIRIQUÍ: valley of upper Río Chiriquí Viejo, alt. 1,300–1,900 m., July 27, 1937, *Peggy & Gene White 22* (Herb. Field Museum, TYPE; Herb. Missouri Bot. Garden, ISOTYPE).

"Growing in open sunlight. Flowers light purple-white with a faint sweet odor." The most closely related species of North America is *Guettarda crispiflora* Vahl, which occurs in mountain forests of Costa Rica and extends to the Lesser Antilles and Trinidad. That differs from the Panama plant in having much less abundant pubescence on all parts, the pubescence consisting wholly of closely appressed hairs. The leaves of *G. crispiflora,* too, are generally narrower and acuminate or long-acuminate, besides being often acute at the base.

PALICOUREA **panamensis** Standl., spec. nov. Frutex 2–3-metralis, ramis ut videtur viridibus obtuse tetragonis glabris, internodiis elongatis; stipulae in vaginam 5–6 mm. longam truncatam extus interdum sparse strigosam coalitae, lobis lineari-attenuatis erectis 6–8 mm. longis rigidis; folia inter maxima longipetiolata membranacea, petiolo gracili 2–6 cm. longo glabro; lamina oblongo-elliptica 12–23 cm. longa 4.5–11 cm. lata, apice subobtusa atque abrupte breviter acuminata, acumine obtuso anguste triangulari paullo ultra 1 cm. longo, basi acuta, supra in sicco viridis glabra, costa nervisque prominulis, subtus multo pallidior, ad costam gracilem prominentem sparse breviter adpresso-pilosula aliter glabra, nervis lateralibus utroque latere ca. 18 tenerrimis prominentibus arcuatis angulo lato fere recto divergentibus juxta marginem arcuato-conjunctis, venulis inconspicuis laxe reticulatis; inflorescentia terminalis anguste thyrsoideo-paniculata erecta 4–5.5 cm. longe pedunculata, ca. 14 cm. longa atque basi 8 cm. lata, laxe multiflora, ramis primariis divaricatis glabris basi bracteatis,

floribus cymosis, bracteis oblongis vel lanceolatis usque 4 mm. longis acutis vel obtusis ciliatis, pedicellis gracilibus rectis glabris usque 7 mm. longis; fructus juvenilis subglobosus basi rotundatus 3 mm. longus glaber, sepalis persistentibus ovali-ovatis viridibus acutis vel acuminatis usque 2 mm. longis.—CHIRIQUÍ: valley of upper Río Chiriquí Viejo, alt. 1,300–1,900 m., July–Aug., 1937, *Gene & Peggy White 14* (Herb. Field Museum, TYPE; Herb. Missouri Bot. Garden, ISOTYPE).

"Stems bright purple; fruit light green with dark green stripes. Growing in shade." The mature fruits doubtless are substantially larger than the description indicates. The branches are hollow. Like most *Palicourea* species, this has no outstanding characters, but it is unlike any other species known from Panama or adjacent regions.

GENERAL INDEX TO VOLUME XXV

New scientific names of plants and the final members of new combinations are printed in **bold face** type; synonyms and page numbers having reference to figures and plates, in *italics;* and previously published names and all other matter, in ordinary type.

Q

R

T